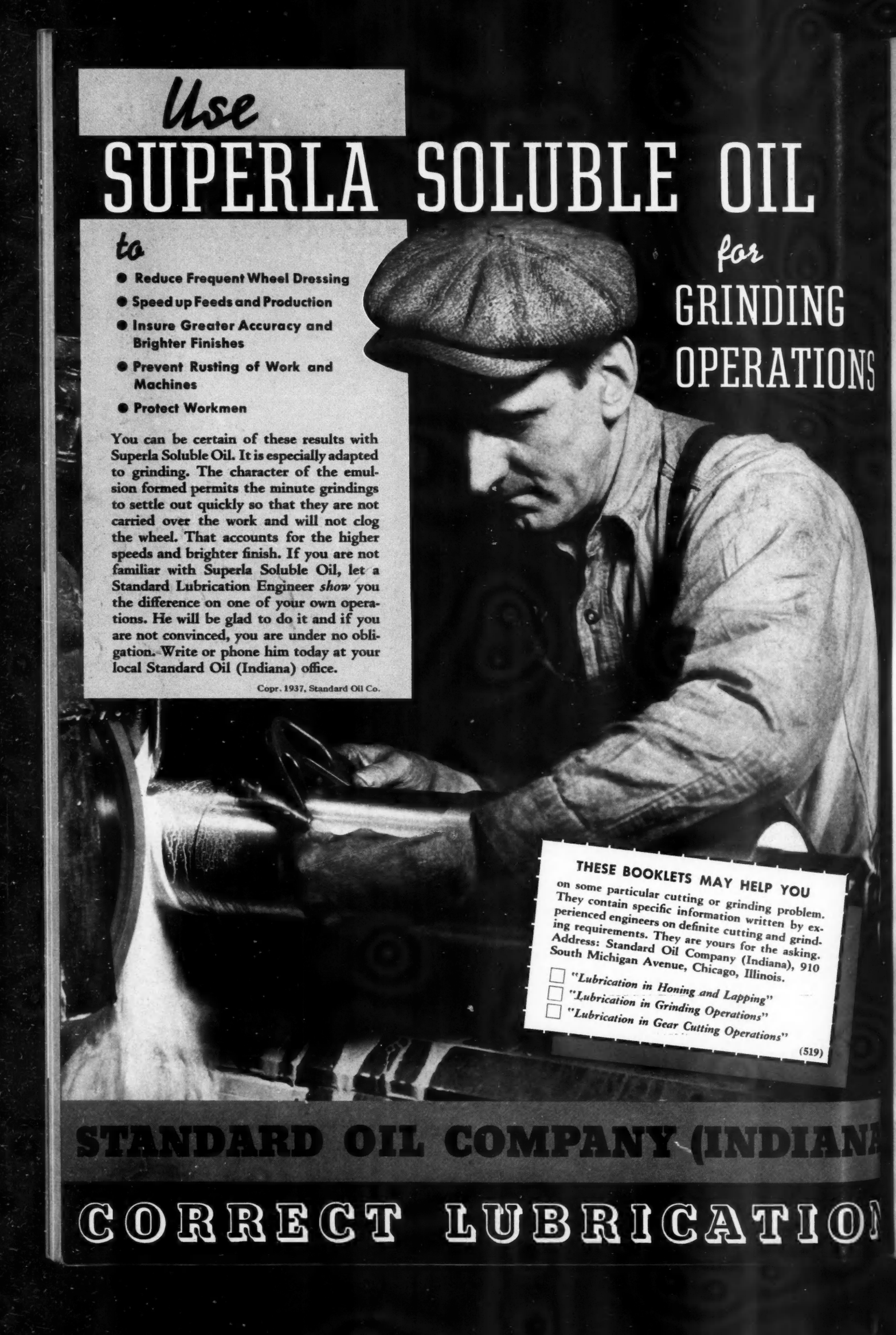
AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER

MAY 8, 1937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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Weekly

Volume 76 Number 19

Contents

News of the Industry 679

Calendar of Coming Events 682

Business in Brief 685

Production Lines 689

Foundry Layout Facilitates Quality Control. *By Joseph Geschelin* 690

S.A.E. Summer Meeting Blankets Developments in the Industry 693

Mechanical Drawings of the Jewett "Flat Four" Automobile Engine 705

Automotive Abstracts 707

Advertisers' Index 42-43

C. A. MUSSELMAN, Pres.; J. S. HILDRETH, Vice-Pres. and Manager, Automotive Division; G. C. BUZBY, Vice-Pres.

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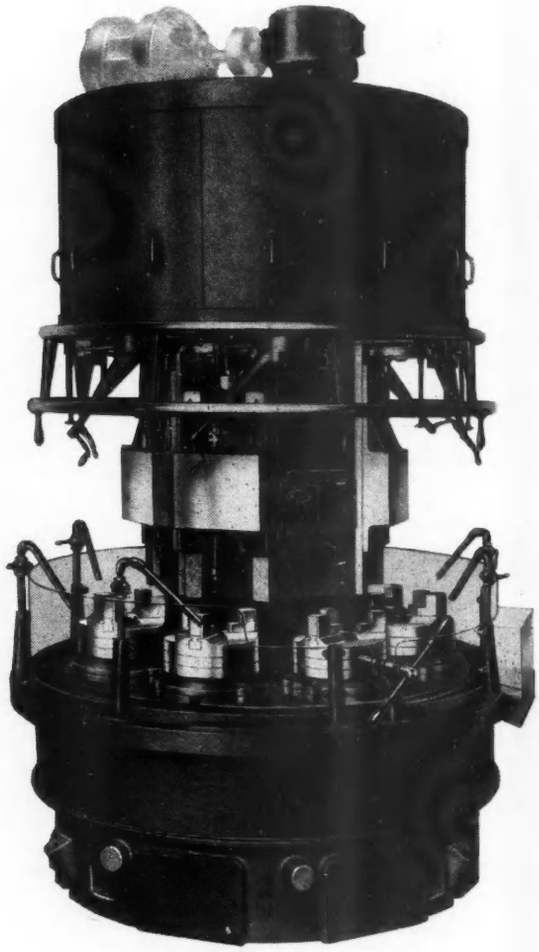

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12 inch – 6 Spindles
12 inch – 8 Spindles
16 inch – 8 Spindles

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Bridgeport · Conn.

AUTOMOTIVE INDUSTRIES

Founded 1895

Vol. 76, No. 19

May 8, 1937

May Seen As Peak Month

Motor-Vehicle Production Expected to Reach Apex

Motor vehicle production for this year has crossed the 2,000,000 unit mark and is climbing at the rate of about 28,000 units each working day toward the 1937 goal of at least 5,000,000 cars and trucks. Forty per cent of the current year's quota was reached in just a little more than four months and at the industry's present rate of output the half-way mark should be reached about the first week in June. Last year output was at the half-way point about the third week in June. Since the introduction dates for new models have been moved from January to early autumn production has been more evenly distributed so that the first six months and the last half of the year are almost in balance.

The first quarter's output this year of 1,301,681 cars and trucks compared with 1,117,172 in corresponding period of 1936, a gain of 15.15 per cent. If this rate of increase is maintained for the balance of the year the total 1937 production will exceed 5,300,000 units, or a gain of approximately 700,000 vehicles. So far this year the industry has picked close to 200,000 units over corresponding period last year.

Final figures covering April are not yet available for leading producers but indications are that around 525,000 cars and trucks were built last month, which means that production was just about on the level with April last year when the total for U. S. and Canada was 527,726 units. Approximately 70,000 vehicles were dropped from the April output on account of strikes. It was almost the middle of the month before Chrysler and Hudson were back in full stride again, and Reo was even lated in resuming. Sporadic sit downs at other plants also cut into the month's production.

May found all plants in full swing and prospects good for uninterrupted operations throughout the month. In all probability, May will establish the production peak for 1937, despite the fact that it has only 21 working days.

(*Turn to page 688, please*)

This Week

ALFRED P. SLOAN, JR.
. . . was made chairman of the board of the General Motors Corp., with Donaldson Brown as vice-chairman, in a move which elevated . . .

WILLIAM S. KNUDSEN
. . . to the presidency of the corporation. Mr. Knudsen had been executive vice-president since 1933, and will continue in charge of all operations.

The Past

GM—Chairmen of the Board

Thomas Neal, Nov., 1912-Nov., 1915
Pierre S. du Pont, Nov., 1915-Feb., 1929
Lammot du Pont, Feb., 1929-May, 1937

GM—Presidents

George E. Daniels, Sept., 1908-Oct., 1908
William M. Eapon, Oct., 1908-Nov., 1910
James J. Storrow, Nov., 1910-Jan., 1911
Thomas Neal, Jan., 1911-Nov., 1912
C. W. Nash, Nov., 1912-June, 1916
W. C. Durant, June, 1916-Nov., 1920
Pierre S. du Pont, Nov., 1920-May, 1923
Alfred P. Sloan, Jr., May, 1923-May, 1937

General Motors Enters New Phase

Broad Executive Changes Fix Shift in Responsibilities

Meeting Monday, May 3, the General Motors directorate approved sweeping changes in the high command of the organization, which emphasize the division of responsibility between operating and financial policies of the organization and diminish the active participation of duPont-Morgan interests in the executive affairs of the Number One automobile manufacturing organization of the world.

Dramatic in its suddenness, the move elevated Alfred P. Sloan, Jr., president of the corporation since May, 1923, to chairman of the board, with Donaldson Brown, former chairman of the finance committee, as vice-chairman of the board.

William S. Knudsen, executive vice-president of the corporation, and prime negotiator in its recent dealings with the United Automobile Workers Union, was made president in a move which emphasizes the large part he has played in operating management of the corporation's recent expansion.

Satisfaction of stockholders at the move was augmented by the declaration of a $1 dividend on the common stock, and the customary dividend of $1.25 on the preferred.

Lammot duPont, chairman of the board of the corporation since February, 1929, declined reelection because of his other business responsibilities, primarily as president of E. I. duPont de Nemours & Co.

Marvin E. Coyle, general manager of the Chevrolet division of the corporation was elected a vice-president. Floyd O. Tanner, who deals with labor relations as a member of the corporation's general staff, was also elected a vice-president.

The executive committee and the finance committee were abolished and replaced by two new committees (administrative and policy) each implemented with men who have an active part in the corporation's operations, and launched with a clear definition of their respective duties.

Members of the administrative com-

(*Turn to next page, please*)

Sloan and Knudsen Upped in GM Shift

Broad Changes in Executive Responsibility Charted By Corporation; Divisions Not Affected

(Continued from preceding page)

mittee, besides Mr. Sloan as chairman, included Albert Bradley, senior vice-president of the corporation; Lawrence P. Fisher, vice-president of the corporation and general manager of the Cadillac division; Richard H. Grant, vice-president and sales director of the corporation; O. E. Hunt, vice-president and director of engineering; James D. Mooney, vice-president of the corporation and director of its export activities; Ronald K. Evans, a vice-president of the corporation; R. E. Wilson, a vice-president of the corporation; Mr. Knudsen and Mr. Tanner.

A statement issued by Mr. Sloan, said, in part, that the changes in executive structure "finalize, in concrete form, a procedure which has been in process of evolution for some years past." He also pointed out that yesterday's was the first meeting of directors since the annual meeting on April 27.

Mr. Sloan pointed out that the changes involved two important features, one affecting executive and the other committee responsibility.

"As to the first," he said, "heretofore the president has been the chief executive officer of the corporation. That is now changed. The chairman of the board now becomes the chief executive officer.

"As to the second, heretofore the final authority as to the financial function has been the finance committee, and as to the operating function the executive committee. Both these committees, as such, have been eliminated.

"A policy committee has been established. This committee will have jurisdiction on questions of broad corporation policy, involving both finance and operation. In addition, it will likewise, have the responsibility of promoting new methods of operating technique from the policy standpoint, involving all functional activities throughout the corporation's operations.

"In addition, an administration committee has been established. This committee will have complete charge of the administration of the business and, in collaboration with the policy committee, the development of forward operating policies.

All divisions and subsidiaries of the corporation, except those of a strictly financial character, will be under the general jurisdiction of the administration committee.

"The new plan now adopted is based upon the conviction that the broader problems of management divide themselves into two groups, one involving policy and the second, administration of policy.

"While it is recognized that there can be no definite border line between the two, however, as applied to General Motors, on account of the magnitude of its operations; the many industries of which it is a part—all in rather a large way—experience has demonstrated that

(Continued on following page)

MARTIN MISSES

Homer Martin, president of the United Automobile Workers union, was proposed for membership on the board of General Motors Corp. at the annual stockholders' meeting in Wilmington, Del., April 27.

Harold Hatcher, of New York, said to be the holder of five shares of GM stock, nominated Martin. Only five votes were cast for him. Hatcher said he was director of research of the Council for Social Action and in proposing Mr. Martin, said: "I believe labor should be represented on boards of directors."

Sloan . . . *Knudsen . . .*

Climb to Top by Different Routes, from Different Backgrounds

Alfred P. Sloan, Jr., president of General Motors Corporation, was born May 23, 1875, in New Haven, Conn., the son of Alfred Pritchard and Katherine Mead Sloan. His father was at that time a wholesale merchant in New Haven.

The family moved to Brooklyn, N. Y., when the son was five years old. There he received his primary education. Having a natural interest in mathematics and mechanics, he later entered the Massachusetts Institute of Technology, from which institution he was graduated in 1895 with the degree of Bachelor of Science.

Upon graduation, Alfred P. Sloan, Jr., went to work for the Hyatt Roller Bearing Company of Newark, N. J., as a draftsman. At that time the value of the roller bearing was not generally recognized, although they were used in the manufacture of machinery to some extent. With the coming of the automobile, the business of the Hyatt company expanded rapidly. Mr. Sloan became president and general manager of Hyatt in 1897 and continued in that capacity until 1916, when Hyatt became a part of the new United Motors Corporation. Mr. Sloan was selected as president of United Motors, which included the Dayton Engineering Laboratories Company, Dayton, Ohio; Remy Electric Company, Anderson, Ind.; New Departure Manufacturing Company, Bristol, Conn.; Harrison Radiator Corporation, Lockport, N. Y.; Jaxon Steel Products Company, Jackson, Mich.; Klaxon Company, Bloomfield, N. J., and several others.

Mr. Sloan continued as president of United Motors for two years. In 1918. when United Motors was taken over by General Motors Corporation, he became vice-president of General Motors. Mr. Sloan became president of General Motors on May 10, 1923, upon the resignation of Pierre S. duPont.

William S. Knudsen was born in Copenhagen in 1879. Mr. Knudsen came to America from his native Denmark at the age of 20. He worked for the Gas Engine and Power Company and Erie railroad, and then joined the John R. Keim Mills in Buffalo, N. Y. After considerable shop experience, he was made factory manager of the Keim Mills, which were merged with the Ford Motor Company in 1911.

In 1913, he entered the Ford motor plant in Detroit and shortly afterward was placed in charge of the Ford assembly plants in the United States. Later he was in charge of production at the Ford Detroit plant. During the World War, he was in charge of Ford boat building activities.

In 1919, he installed three European assembly plants for Ford, and two years later joined the Ireland & Matthews Company of Detroit. In 1922, he joined the General Motors Corporation in an advisory capacity. Soon afterward he was made vice-president of Chevrolet in charge of operations.

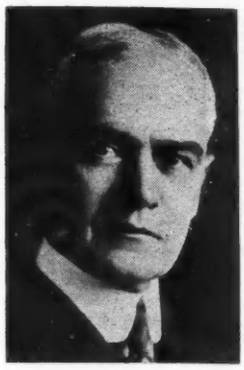
On Jan. 15, 1924, he was elected president and general manager of Chevrolet and made vice-president and director of the General Motors Corporation.

He was appointed executive vice-president of General Motors on Oct. 16, 1933, and became a member of the executive committee.

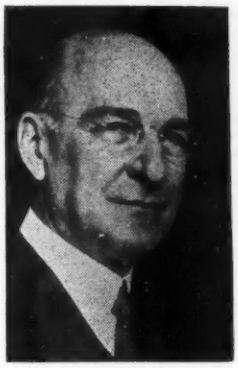
As a tribute to his wife, Mr. Knudsen has just established a fund to be known as the Clara Elizabeth Foundation for maternal and infant care in Flint.

Discussing the gift, Mr. Knudsen stated, "The future of our country rests largely in the family and the child, and therefore I look upon this as a patriotic as well as a social project. The decline of the home and family is usually the route of the countries that go down and out."

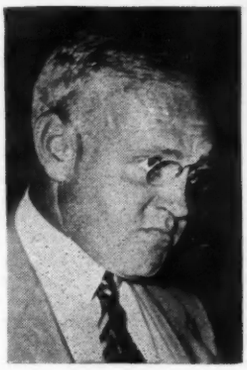
Past and Present Figures in General Motors' Management



THOMAS NEAL
. . . who was first chairman of the corporation (1912) and served as president previously



PIERRE S. DU PONT
. . . president of the corporation from Nov., 1920 to May, 1923; chairman from Nov., 1915 to Feb., 1929



DONALDSON BROWN
. . . formerly vice-president of the corporation and chairman of its finance committee, now vice-chairman of the board

LAMMOT DU PONT
. . . retiring chairman of the board, who served in that capacity from Feb., 1929 to May, 1937

these two functions become quite separate in character—sufficiently so as to permit them to be dealt with, to an important degree, independently.

"Experience has also shown that, owing to the pressure under which the corporation's executives operate, the demands of administration limit the opportunity for the effective development of advanced policies, particularly as there is involved in their evolution much study and research. While the success of the corporation will always depend upon effective administration, the policy phase is becoming, through evolution, of greater and greater importance.

"It is for that reason that the new organization has been set up, having in mind a broader distribution of the executive load, thus permitting the concentration of greater executive attention on that phase of business. It might be added that such a procedure is of particular importance at this time, in view of the period of rapid change through which business, all over the world, is now passing.

"No changes are involved in the organization of the corporation's divisions and subsidiaries, or in their relationship to the general staff."

GM Opens Linden Plant

The Linden, N. J., plant of General Motors, one of the largest automobile assembly plants in the world, has been completed and has been put into operation, it was announced May 4.

The first car to leave the assembly line marked the official start of a production operation capable of supplying 120,000 Buicks, Oldsmobiles and Pontiacs a year.

The plant, occupying an 80-acre site on State Highway 25 & Edgar Road, was erected at a cost of $5,575,000. When operating at full capacity it will provide employment for approximately 2000 persons.

The completion of the Linden division provides General Motors with an ultra-modern plant in the heart of the industrial East, and marks another step in the decentralization of production of Buick, Oldsmobile and Pontiac automobiles by General Motors. A similar plant was established in Los Angeles last year to serve the West Coast region. Prior to that time all three makes had been assembled only at the parent plants in Michigan.

Alfred P. Sloan Jr., chairman of the board of General Motors, has consistently advocated a policy of decentralization of industry wherever economically practicable.

The new Linden division will be under the general managership of W. S. Roberts.

The four buildings at Linden are of the most modern steel and brick construction; floor space totals nearly 1,000,000 sq. ft. and an oval test track approximately three-eighths of a mile in circumference. The buildings consist of the main factory, an office building, a loading dock and a powerhouse. The main factory is 680 ft. wide and 1080 ft. long, of one and two-story construction, and houses complete body as well as chassis assembly operations.

The office building is a two-story and basement structure with an area of 45 by 200 ft. The loading dock is 450 ft. long by 50 ft. wide and the powerhouse is 125 by 100 ft. Albert Kahn was the architect and J. A. Utley Co. were the general contractors.

Cadillac Passes Peak

Shipments of 1937 Cadillacs and the La Salle V-8 crossed the 30,000 mark last week to give this G. M. division the best half year record in its history.

"The first six months of new model sales far overshadows previous figures," said Sales Manager D. E. Ahrens. "Our former peak was registered in 1928 when we produced 41,474 cars over the complete year."

Mr. Ahrens further disclosed that current operations have surpassed shipments for all of the 1936 series. Last year, 25,905 cars were shipped. Current orders are running at about 300 per day.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Pivotal Steering

Rhys Jenkins, the well-known English motor authority, proves quite conclusively that the pivotal steering now in common use on motor vehicles is of more ancient date than usually supposed. He says:

"In the 'Machines Approuvées par l'Académie Royale des Sciences,' Vol. III, are given descriptions of carriages propelled by windmills brought before the Academy in the year 1714 by M. Du Quet. The wheels are mounted on short axles, each fixed in a vertical post provided at top and bottom with pivots which work on suitable bearings in the framework of the carriage. Standing out from the posts at right angles to the axles are arms to which are secured the ends of a rope wound around a capstan also carried in the carriage frame."

—From *The Horseless Age*, May, 1897.

De Soto on Park Avenue

A new Park Avenue automobile salon for the display of Plymouth De Soto and Chrysler motor cars was opened this week on the ground floor of the Ritz Tower, 57th Street and Park Avenue, New York.

Sponsored by the De Soto New York company and Chrysler New York company, the new salon is a direct factory branch and will be maintained as a permanent showroom. It will be under the direction of George D. Lynn, who has been named president of the De Soto New York company.

How to Handle it with Rex **Belt Conveyors:** a catalog of **equipment** and **engineering data** book issued by the Chain Belt Co., Milwaukee. 114 pages, board covers.*

The Cavalcade of **Diesel.** An address by John B. Kennedy celebrating the fortieth anniversary of the Diesel engine. Published in pamphlet form by the Caterpillar Tractor Co.*

High-Intensity **Mercury Lighting.** A 32-page section from the Westinghouse general catalogue describing many types of industrial lighting equipment for use with 200 and 400-watt high intensity mercury-vapor lamps.*

The Voice of Modern Business. Describes various available combinations of the Strowger P-A-X **intercommunicating telephone** systems.*

1937 Laws Bulletin. A digest of new legislation affecting highway users. Published by the National Highway Users Conference, Washington.*

Scrap and America. The story of what is happening to America's supply of **scrap iron and steel,** told in pictures and text sponsored by the committee on scrap of the Independent Iron and Steel Producers [association], New York.*

Travel by Covered Wagon. The de luxe presentations of new models by the automobile manufacturers have their counterpart in the **tourist trailer** industry. This is one of the best to date.*

Air-Weight Control, a booklet of particular interest to the **foundry** trade, has been issued by the Foxboro Co., Foxboro, Mass.*

The Bijur Lubricating Corp., Long Island City, N. Y., has brought out a new bulletin which describes its **automatic lubricating system.***

The **Social Security Act**—What it is and What it Does. A mimeographed information circular of 25 pages, published by the Business Information Division of the Social Security Board, Washington.

Bulletin 91 of the Copper and Brass Research Assn. contains a number of interesting references to the use of copper and its alloys in aircraft and motor-vehicles.*

Productivity as a Remedy for inflation is the title of No. 21 in a series of booklets on subjects of current economic interest published by the Farrel-Birmingham Co., Inc., Ansonia, Conn.*

April issue of The Mainspring, Wallace Barnes Co. house organ, contains an article on the production of 17th Century steel.*

Iron founders are listed alphabetically and geographically in a Directory of Members for 1937, published by the Gray Iron Founders' Society, Inc.*

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

Excise Taxes on Cars and Trucks Were Lower in March

Collection of excise taxes on automobile trucks showed a decline while a sharp increase was shown for automobiles and motorcycles in March, 1937, compared with March, 1936, according to the Bureau of Internal Revenue, Treasury Department. The most important increase in tax collection was from the sale of tires.

Comparative figures on excise collections on automotive products, gasoline and lubricating oil follow:

	March, 1937	March, 1936
Automobile trucks	$264,786.70	$434,118.54
Automobiles and motorcycles	2,781,581.16	2,522,938.81
Automobile parts and accessories	628,765.11	470,029.73
Tires	2,551,724.08	1,316,681.76
Inner tubes	530,357.70	270,545.20
Lubricating oils	2,057,293.36	1,393,367.92
Gasoline	12,970,980.46	8,838,869.66

Letters to AUTOMOTIVE INDUSTRIES

THE GREENER PASTURES—OVER THE FENCE

An American Says:

It is a sad commentary upon the situation as to the publication of American technical literature respecting the automotive industry, that I find it best to subscribe for a British publication in order to find out details of engineering work being done upon American cars. I would be much happier to spend the same money for an equally thorough treatment of the problem involved—by an American publication.

R. R. KEITH
Racine, Wis.

An Englishman Says:

May I say how much I appreciate AUTOMOTIVE INDUSTRIES. We have nothing in England to compare with it, not even at six times the cost.

J. MILNE
Guildford, Surrey, England.

Calendar of Coming Events

SHOWS

Norway, Automobile Salon—Oslo..May 7-10
Second Annual Automobile Maintenance Show, San Francisco.....May 20-23
Morocco, Automobile Section, Tangier Fair, Tangier .....June
France, Automobile Section, Bordeaux Fair, Bordeaux .....June 13-28
Belgium, First International Aeronautical Salon, Brussels.....June 18-30
Fourth ASTM Exhibit of Testing Apparatus and Related Equipment, New York .....June 28-July 2
Poland, Automobile Salon (Foire Orientale), Lwow .....Sept. 1-15
France, 31st International Automobile Salon, Paris .....Oct. 7-17
Great Britain, 31st International Automobile Exposition, London....Oct. 14-23
Czechoslovakian Automobile Show, Prague .....Oct. 16-24
National Automobile Show, New York, Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .....Oct. 28-Nov. 8
Buffalo, N. Y., Automobile Show, Oct. 30-Nov. 6
Cincinnati Automobile Show.Oct. 31-Nov. 6
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London...Nov. 4-13
Chicago Automobile Show.....Nov. 6-13
Akron Automobile Show.....Nov. 6-12
Omaha Automobile Show.....Nov. 6-11
Brooklyn Automobile Show.....Nov. 6-13
Columbus Automobile Show.....Nov. 6-13
Detroit Automobile Show.....Nov. 6-13
Kansas City, Mo., Automobile Show, Nov. 6-13
Motor Truck Show, 4th Annual, Newark, N. J.....Nov. 6-12
Newark, N. J., Automobile Show..Nov. 6-13
Philadelphia Automobile Show....Nov. 6-13

Show Business

Manager of the National Automobile Show in New York is Alfred Reeves, 366 Madison Ave., N. Y. C. Inquiries concerning all matters connected with the national show should be addressed to him. AUTOMOTIVE INDUSTRIES will be pleased to furnish names and addresses of local show managers on request.

Pittsburgh, Pa., Automobile Show.Nov. 6-13
Toronto, Ont., Automobile Show..Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .....Nov. 12-20
Baltimore, Md., Automobile Show, Nov. 13-20
Cleveland, Ohio, Automobile Show, Nov. 13-20
Jersey City, N. J., Automobile Show, Nov. 13-20
Milwaukee, Wis., Automobile Show, Nov. 13-20
Springfield, Mass., Automobile Show, Nov. 14-20
St. Louis, Mo., Automobile Show.Nov. 14-21

CONTESTS

Indianapolis Speedway, 500-Mile International Sweepstakes .....May 31
31st Annual Grand Prix of the Automobile Club of France, Linas-Montlhéry .....July 4
Pan American Cup Race, Roosevelt Raceway .....Sept. 6
National and International Soap Box Derby Finals, Akron, Ohio.....Aug. 15
Roosevelt Raceway, 400-Mile George Vanderbilt Cup Sweepstakes.....July 5
National Outboard Championship Regattas, Richmond, Va.....Sept. 18-19

CONVENTIONS AND MEETINGS

National Battery Manufacturers Asso., Spring Convention, Shoreham Hotel, Washington, D. C.....May 13-14
American Society of Mechanical Engineers, spring convention, Detroit, May 17-21
National Association of Purchasing Agents, 22nd Annual Convention, William Penn Hotel, Pittsburgh, Pa. .....May 24-27
American Petroleum Institute, Mid-Year Meeting, Colorado Springs, Colo. .....June 1-3
Second World Petroleum Congress, Paris, France .....June 14-19
Automotive Engine Rebuilders Association, 15th Annual Convention, Chicago .....June 21-24
American Society for Testing Materials, 40th Annual Meeting, New York, June 28-July 2
American Transit Association, 56th Annual Convention, White Sulphur Springs, W. Va.....Sept. 19-23
S.A.E. Fuels and Lubricants Regional Meeting, Tulsa, Okla. ...Sept. 30-Oct. 1
S.A.E. National Aircraft Production Meeting, Los Angeles, Calif.....Oct. 7-9
S.A.E. Annual Dinner, Commodore Hotel, New York.....Oct. 28
American Petroleum Institute, 18th Annual Meeting, Stevens Hotel, Chicago .....Nov. 9-12
S.A.E. National Production Meeting, Flint, Mich. .....Dec. 8-10

Labor Howls at Proposed Restrictions

Murphy-Sponsored Bill in Michigan Legislature Regarded By Governor as "Framework" for Building Upon

Governor Murphy's labor relations bill, introduced in the Michigan state legislature last week, has met with loud protests from organized labor. Employers, while admitting some changes would be desirable, have raised no serious objections to the proposed legislation. The bill, now in the House Committee on Labor, is expected to undergo considerable revision before it is brought to a vote. The Governor is not opposed to changes, regarding it merely as a framework upon which to build needed legislation.

In its present form, it sets up a labor relations board of three members to be appointed by the Governor with consent of the Senate, which would investigate labor disputes and arrange for their adjustment. The board would have power to take the initiative and not wait to be invited in a dispute. In effect, it provides for compulsory arbitration. Rights of labor to organize are protected. Picketing for the purpose of intimidating or blocking ingress or egress from places of business would be prohibited. Courts would not be permitted to issue injunctions except under certain conditions, such as where strikers are wilfully destroying property or barring entrance or exist from private property by picketing. While not requiring incorporation of unions, the bill would compel labor organizations to file with the board the names of their officials, details of their legal set-up, copies of agreements with employers and permit examination of records and books.

An important feature is the discretionary power that would be given the Governor to close any industrial plant in the state or permit it to operate. The bill provides that "if in his judgment the public interests shall require it, the Governor may by proper order place such establishment temporarily in charge of the commissioner of Michigan State Police pending any further efforts at mediation." Moreover, strikes and lockouts would become a violation of the act if, in the judgment of the Governor, such action "would cause grave injury, hardship or inconvenience to the public."

One of the big objections to the bill is the dictatorial power it places in the hands of the Governor. This was pointed out by Homer Martin, president of the United Automobile Workers Union, who said "We are not ready for a Hitler yet," and adding "Murphy will not always be Governor."

The union sees in the bill an encroachment or restriction upon the right to strike. "The workers will never surrender this right," said Mr. Martin pointing to the Wagner Labor Act which specifically protects the works in this right.

"Other provisions of the bill," he declared, "are obviously intended to permit of attacks upon labor unions by agencies controlled and dominated by the employer. Labor in the past has been able to take care of its own affairs. There already has been too much interference by employers through the use of spies, stool pigeons and thugs without the addition of governmental sanction to an inquisition into unions which can have no other object than to demoralize them and aid in the union-busting movement of the employers.

"We are struck with the similarity of many provisions of the bill with the recommendations made during the past week in relation to such legislation by the National Manufacturers Assoc. and the U. S. Chamber of Commerce. Many of the provisions find their inspiration in the Liberty Leaguers.

"The anti-injunction features are obviously far from the provisions of the Federal anti-injunction bill, known as the Norris-LaGuardia Act, passed by the U. S. Congress in 1932. This Federal law has application to all of the Federal courts. A law for the State of Michigan, modeled directly upon this Federal law, has already been introduced in the state legislature by representative Joseph Murphy of Detroit, and it should be passed instead of a bill which presumes to incorporate some of its features but in reality emasculates them."

Rep. Philip J. Rahoi, one of the sponsors of the proposed act, has withdrawn his support, declaring it would give the Government too much power and would prove an injustice to organized labor. He has introduced a Labor Relations Act for Michigan which the union is supporting.

The UAWA refuses to take seriously the formation of new unions in the automobile industry, such as the American Labor League and the Independent Automobile Employes Association. "The leadership and program of these organizations too definitely stamps them with company unionism to permit them to make any progress at all," said a statement issued by the General Executive Board of the UAWA, in session in Detroit.

"Their avowed friendship for the AFL will also be an obstacle to their organizing automobile workers," it was further pointed out. "Automobile workers, after years of tragic experience with company unions, independent unions, and the AFL have definitely rejected these types of organizations in favor of one industrial union—the UAWA."

Whether this is an expression of confidence on the part of union leaders or a case of whistling in the dark is a question. Certainly the UAWA and its parent, the CIO, is running into increasing opposition in the automobile sector. Recent moves on the part of the AFL indicate a renewal of that organization's drive for membership among automobile workers. F. J. Dillon, who just a year ago was replaced by Homer Martin as president of the UAWA, has been assigned by the AFL to the Toledo district to begin a drive in the metal trades industries which

(Turn to page 688, please)

SURROUNDED by some of the 2040 entries in a body-design contest sponsored by the Toyota Automobile Co. (Japan), two of the judges pause for a photograph. The design contest is now an annual feature of the Toyota company's development program, and by its large entry list indicates Japanese popular interest in motor vehicles. Judges shown are: (l. to r.) Baron Ino Dan, artist, and Hideo Kishida, doctor of engineering. Prize of 1000 yen was awarded to Eizaburo Musa, whose design, like most of the others submitted, managed to combine "artistic" streamlining with characteristic Japanese ideas of design.

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The technical papers covered a range of subjects that included aircraft powerplants, cab-over-engine trucks, aircraft radio shielding, oil temperature control, lubricants, vehicle performance, safety gadgets, trailers, hypoid gears, Diesel engines, and body design. The trailer session was augmented by an informal outdoor exhibit of various types and makes of trailers. Abstracts of some of the papers are published in this issue of AUTOMOTIVE INDUSTRIES, beginning on page 707, others will appear in issues to follow.

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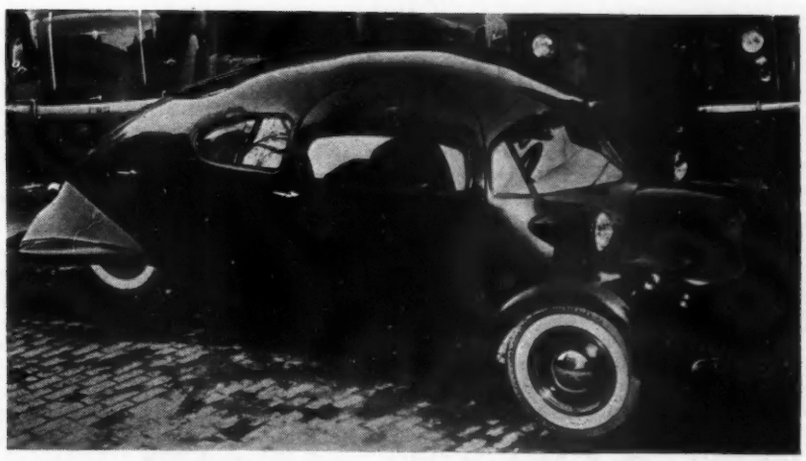

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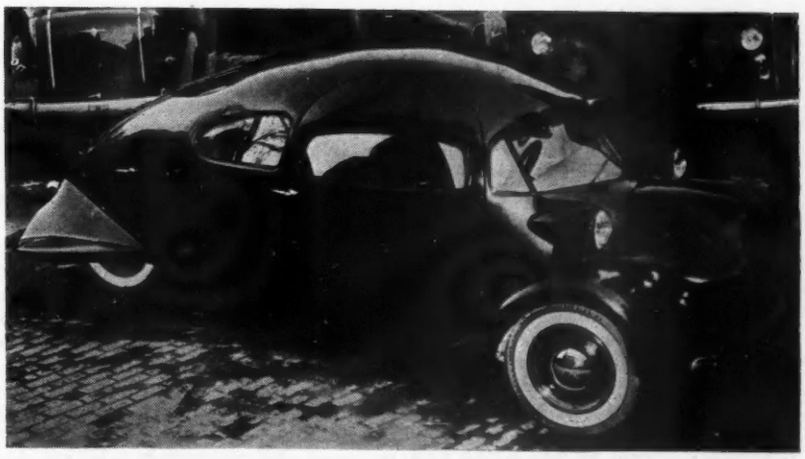

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VISITORS to the new DeSoto plant in Detroit no longer have to ask guides to "speak a little louder, please." With the plant wired for sound, guides pick up hand microphones at convenient stations, spiel in comfort. Picture shows: Guide Ross MacPherson chaperoning typical group of visitors. Interested members of the public get two plant trips daily: 9:30 a.m. and 2:00 p.m., except Saturday and Sunday.

Diesel Maintenance Progresses

Has Been Reduced to Routine Similar to That Established For Gasoline Types; Oil Treatment Beneficial

A general review of recent developments of the compression-ignition engine (oil or Diesel) has been prepared and published in England by the Diesel Engine Users' Association. A large proportion of it is devoted to this type of engine as manufactured for agricultural haulage and road transport vehicles.

On combustion chamber design, the review expresses the opinion that there has been little development during the past year or two, apart from some variations of form in the group represented by the Ricardo Comet and Oberhansli types, in which the fuel is injected into a separate chamber.

After referring to the extension of research on the subjects of ignition and combustion without recording the results in detail, the report leads up to matters concerned with design features from the maintenance point of view; the following are extracts from this section:

"Bearing trouble is now much less than formerly. Steel-backed white-metal main bearings are widely used, with big-ends in which the upper half is made of aluminium alloy and the lower half of white metal. A lead-bronze alloy for both main and big-end bearings gives satisfactory performance, and if the cost were reduced its application could be extended. Where aluminium or lead-bronze alloys are used, the crankshaft journals should be hardened to prevent excessive wear and to avoid undue damage in case of seizure,

"Aluminium-alloy pistons are used practically universally and little trouble is experienced with them. Pistons have recently been tried with two scraper rings below the gudgeon pins, and excellent oil-consumption figures have resulted. The wear on pistons is found to be small, and they may run from 120,000 miles to 150,000 miles, after which there is danger of failure due to fatigue.

"Excessive wear of cylinder liners has largely been overcome with the introduction of nitrogen-hardened cast-iron types of about 950 Brinell. With these it is possible to obtain a "wear" figure of from 20,000 miles to 25,000 miles per 0.001 in., which compares favorably with the figure of 6,000 miles for the same amount of wear in the case of an ordinary cast-iron liner of 450 Brinell. It is, therefore, possible to obtain 100,000 miles running from the original liner, after which it may be ground to .02 in. oversize, and a further 50,000 miles obtained. Hardened piston rings are used with such liners.

"A new process known as the Listard is now available. In this chromium is electrically deposited on the cylinder bore, giving a surface of great hardness and durability. Exhaustive tests in service have not yet been made, but, so far, it would appear that an increase in cylinder life will be obtained.

"With the indirect-injection engine it is necessary to change the crankcase oil completely once a fortnight, or after about every 2000 miles of running, owing to thickening by carbon formation. It has now been found possible to reclaim crankcase oil by forcing it through filter pads of closely compressed paper, which remove the minute particles of suspended carbon.

"There has been no real change in the methods of dealing with atomizers and fuel pumps. Treatment of the fuel by passing it through a centrifuging machine before issue to the vehicle, and then through an efficient filtering system before reaching the engine fuel pump obviates frequent trouble from atomizers. This practice is more important on a direct-injection engine, where the nozzle holes vary from .008 in. to .012 in. in diameter.

"The maintenance of oil engines has been reduced to a routine similar to that for gasoline engines, and few difficulties are experienced. It is found that valves usually require regrinding at 15,000-mile intervals, while a lay-up, including examination of bearings, pistons, etc., is necessary at 45,000 miles, and a complete overhaul, including crankshaft grinding, at, roughly, 90,000 miles. With the reduction in the price of spares and increased life of liners, the cost of the overhaul of an oil engine is no greater than that of a gasoline unit, being about 2d [4 cents] per mile."

Casing Shipments Off

Shipments of pneumatic casings during the month of January are estimated at 4,509,240 units, a decrease of 10.1 per cent under December but were 16.4 per cent above shipments made in Jan-

uary, 1936, according to the Rubber Manufacturers Association, Inc.

This organization estimates production of pneumatic casings for January at 4,980,174 casings, a decrease of 6.2 per cent under December but was 8.8 per cent above January, 1936.

Pneumatic casings in the hands of manufacturers, Jan. 31, 1937, are estimated at 11,377,015 units, an increase of 2.4 per cent over the stocks on hand Dec. 31, and 27.6 per cent above stocks on hand Jan. 31, 1936.

PNEUMATIC CASINGS

	Shipments	Product'n	Inventory
Jan., 1937	4,509,240	4,980,174	11,377,015
Dec., 1936	5,015,872	5,311,007	11,114,399
Jan., 1936	3,875,120	4,578,994	8,917,390
Jan., 1935	3,662,615	4,626,473	10,397,667

More Tools Needed

Industry's Burden of Obsolescence "Staggering," says Burt

While the last two years have seen progress in the rehabilitation of manufacturing plants toward greater efficiency "there still rests upon metal-working plants a staggering burden of obsolescence," according to Clayton R. Burt, president of the National Machine Tool Builders' Assn.

Speaking before the spring convention of the association, held in Chicago, May 3 and 4, Mr. Burt dwelt on the fact that "outmoded equipment cannot increase production enough to bring down unit costs to the point to which they must come if prices of finished products are to remain within consumer ability to buy."

"We need to put more machines to work," he said, "and train more operators to man them efficiently."

Amplifying his belief that the prosperity of the country rests upon the maintenance of a sound and prosperous machine-tool industry he offered this principle: "Any restrictions, economic or political, that divert the attention of the machine tool builder from his primary function of designing and supplying needed industrial equipment is a drag upon progress."

Listed Securities Slump

April Showers Hit Motor-Vehicle Stocks with Others

Motor vehicle securities listed on the New York Stock Exchange shared in the April recession which hit the security markets. According to a compilation by Frazier Jelke & Co., seven representative motor stocks declined in market value from $3.50 billion to $3.23 billion (7.8 per cent) in the month ending April 30. Utilities, mines, steels, foods and buildings suffered more than motors from the effects of the decline. Rails, industrials, oils, equipments, electricals, and merchandising (least) groups were less hard hit.

Labor Factions Vote for Harmony in South Bend

Complete harmony within union labor ranks in South Bend was assured for the immediate future following a meeting of the South Bend Central Trades and Labor union and delegates from all organized labor units in the city.

Voting not to expel delegates from unions affiliated with the Committee on Industrial Organization, the group settled the argument presented by organizers from both CIO and American Federation of Labor. Following the meeting, leaders of both groups expressed satisfaction that cooperation should rule the activities of labor within the city. They emphasized, however, that the clash between the two powerful labor factions has had little effect in South Bend and harmony has prevailed in the city for some time.

The Once Over

By H. I. PHILLIPS

IMAGINARY INTERVIEWS

Mr. Lewis and Mr. Ford

JOHN—How are you, Henry?

Henry—Oh, I'm able to sit up.

John—Never mind about that; how are you sitting down?

Henry—You'll find out.

* * *

John—You are quoted as saying the C.I.O. will never unionize the Ford plants. Did you really say that or was it just a case of your motor skipping?

Henry—I said it and I mean it. I'll close my shops first.

John—Let's cooperate and close them together.

Henry—Where do you get off unionizing auto plants? I thought you were a coal miner.

John—Oh, I was a coal miner, but I figured in an accident. Everything went black and when I woke up I was unionizing everything.

* * *

HENRY—This sitdown stuff makes me sick. Nobody ever makes any progress sitting down.

John—How silly! Look at the C.I.O.!

Henry—Suppose I had spent all my time sitting instead of slaving away to perfect the Model T?

John—Henry, you contributed more to the art of sitting down than anybody in industrial history. Lizzie took the entire country off its feet.

Henry—Why are you determined to start a row in my plants? I've always paid labor the highest wages.

John—I promised Chrysler and Sloan that I wouldn't show any partiality.

* * *

HENRY—Strikes are too costly. I can't afford to include 'em within my price range.

John—Nonsense. I've got 'em down where anybody can afford 'em. I can turn out a dozen big strikes for what it once cost to produce one little one, and I got the idea basically from you.

Henry—How so?

John—Quantity production!

* * *

Henry—I was the first man to adopt a five-dollar minimum wage in this country; I pioneered the higher wages movement in industry. The workers of America never forget.

John—That shows what you know about workmen. I'll unionize your business if it's the last thing I do.

Henry—If you try it, it will be the LAST thing you'll do!

John—Five dollars a day! Why, I pay my valet, my butler, my private secretary, my chauffeurs and my gardener more than that.

Henry—Do you have a valet and a butler?

John—Shush! Not so loud!

* * *

HENRY—Get this straight. I'll shut every Ford plant in the country before I'll let the C.I.O. touch a hair of Lizzie's head.

John—Let's not quibble. What difference does it make whether you close 'em or I close 'em? The Point is to close 'em.

Henry—The whole idea of you presuming to dictate to me is offensive. Why, I'd have you understand I began life as a penniless mechanic and became the greatest industrialist in the world.

John—That's nothing. I went from the coal mines to the Presidency of the United States.

Henry—Presidency of the United States! I thought Roosevelt had that job.

John—That's what a lot of people think!

* * *

Packard Bargaining

Progresses Rapidly As CIO Hints New Demands on General Motors

With agreement reached on 20 of the 22 demands upon the Packard Motor Car Co. UAW representatives were hopeful of concluding negotiations before the week was out. The question of sole collective bargaining, the usual obstacle to progress in conferences with management, was settled in Packard's case by an NLRB election which the union won by a big majority.

The UAW general executive board is continuing its sessions in Detroit working on internal problems such as the government of locals as well as plans for organizational campaigns. The board recommended to locals that they take initiative in effecting an establishment of CIO offices and it is expected that action will be taken shortly to form a central CIO council in Detroit which would compete with the central body of the AF of L in the city. The CIO recently announced that it is prepared to issue charters to local industrial unions and city, State and regional councils.

It is predicted in CIO union circles that changes will be sought in the UAW contract with GM when it expires Aug. 11. Under the contract, either party can terminate the pact by giving 60 days notice on or after June 11, 1937, and it is expected that a formal demand for revision will be filed on that date.

Foundrymen Meet

Milwaukee Gathering Draws Largest Attendance in History

Reflecting the marked improvement in the foundry industry, more especially in the automobile, truck and tractor business, the forty-first annual convention of the American Foundrymen's Association opened May 3 in Milwaukee, with the largest attendance ever recorded, fully 7000 registrations being expected before its close Friday afternoon.

Since Milwaukee ranks as one of the leading foundry centers of the country not only in number of shops but also in diversity of cast products manufactured, ranging from a fraction of an ounce to 100 tons, the plant visitation program at this convention was notable.

Automotive foundries were exceptionally well represented as Milwaukee furnishes Detroit more castings of all kinds than perhaps any other city in America. Moreover the great halls of the Milwaukee auditorium were completely filled with an exposition of foundry equipment regarded as the most colorful and comprehensive display in history, more than 200 concerns being represented. At the formal opening of the convention James L. Wick, Jr., Falcon Bronze Company, Youngstown, Ohio, retiring president, made a plea for the further stimulation of interest in improving foundry practices and economical production through activities of the association, particularly for improvement of labor conditions with special reference to apprentice training, citing Wisconsin as the outstanding example of this effort. He emphasized the need for apprentice training because of the current serious shortage of skilled foundry labor because of the lack of interest during the depression when the foundry industry was slack and labor drifted away while youth was distinterested in learning overall jobs.

Richard Bancroft, Perfect Circle Co., New Castle, Ind., and A. H. Dierker, Ohio State University, Columbus, collaborated in an informative paper on ferrite, its occurrence and control in gray cast iron at the opening technical session. A paper on cast iron for nitriding by J. E. Hurst of Staffordshire, England, aroused especially interest among automotive foundrymen.

Investigate Car Prices

And Factory-Dealer Relations Congress Resolution Asks

Acting upon a resolution passed by the Wisconsin Legislature, Representatives Sauthoff and Withrow of that state have introduced resolutions in Congress asking for Federal investigation regarding factory-dealer relations and prices in the automotive industries. The Sauthoff resolution asks the house committee on interstate commerce to inquire into relations between manufacturers and dealers in automobiles. The Withrow resolution directs the Federal Trade Commission to investigate and report to the Senate and the House on "The causes for high prices of automobiles and accessories."

Representative Sauthoff told AUTOMOTIVE INDUSTRIES that the action of the Wisconsin Legislature memorializing Congress to act on relations between automobile dealers and manufacturers grew out of resolutions from both the Automobile Dealers' State Code Authority and the State Bankers' Commission of Wisconsin, copies of which he has received from Madison. The Sauthoff resolution has been to obtain a hearing before the committee urging favorable action in reporting the resolution to the House for consideration. Representative Withrow also is hoping for favorable action. There is doubt, however, that either resolution will be acted upon at the present session of Congress.

Brandel Appointed

C. L. McCuen, general manager of Oldsmobile, has anounced appointment of A. H. Brandel, as assistant manager of manufacturing, succeeding Grey Bernard, resigned. Mr. Brandel is one of the large group of workers and executives who literally have grown up with Oldsmobile.

Bendix Workers to Vote

Position of UAW in Plants Will Be Determined Under NLRB Plan

Bendix Local No. 9, United Automobile Workers of America, will turn to the national labor relations board's new plant election system of determining sole bargaining rights for unions, it has been announced by Thomas Jeffers, president of the union, who said the election will be held at the Bendix Products Corp. plant about May 10. Approval of the election request has been granted by the Federal board in Chicago and will be conducted under its direction. When the labor relations board ordered such an election two years ago soon after the passage of the Wagner act, Bendix officials obtained a restraining order from the United States Circuit Court of Appeals which blocked the election. The Supreme Court's recent decision upholding the constitutionality of the act would have paved the way for removal of the order but Bendix officials had the order dismissed some time ago. The election will involve only the hourly wage workers in the plant, who numbered 4610 according to a statement recently given, while Mr. Jeffers claims there are 4200 union members.

Labor Howls at Restrictions

(*Continued from page 683*)

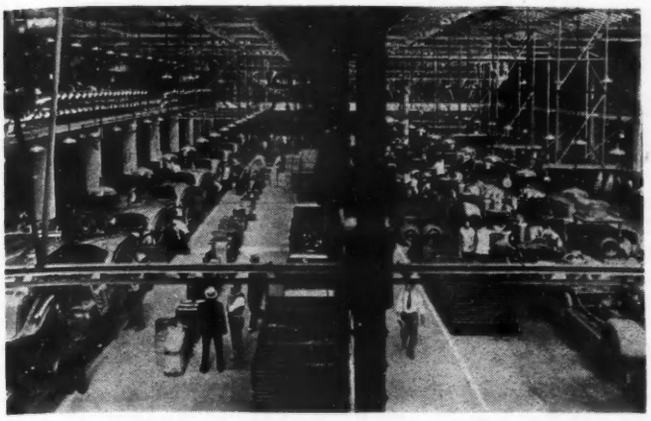
includes automotive factories. It is part of a nation-wide membership campaign of the loyal AFL unions in which they will seek affiliation with the AFL of "all workers without distinction and wherever employed." Dillon admitted that his territory "may include Michigan."

That the newly incorporated American Labor League welcomes the AFL as an ally in its fight against the CIO is indicated in a recent statement by Daniel R. Robins, president of the league, that it is "willing to work as closely as possible with the AFL." In Flint, the CIO faces opposition from various quarters. In addition to the Independent Automobile Employes Assoc., which expects to have 20,000 members by the time the UAWA-GM agreement runs out, a new organization has come forward which combines the forces of a resurrected Ku Klux Klan and Black Legion.

Production Expected to Peak

(*Continued from page 679*)

But it does not seem probable now that the industry will attain a 600,000 unit month on 1937 models. May should come close to that figure, but because of having one less working day than April and two less than March, its potential output is accordingly reduced, since the plants are unable to stretch daily capacity much beyond the present level.



Production Lines

Final assembly line at the De Soto daylight factory

Hard Tools

No one can deny that machine shop practice in the automotive field has progressed at accelerated pace with the introduction of special hard tool materials. Prominent in this category has been Haynes-Stellite J-Metal. Its earlier applications, made by trial and error, have defined today's practice and definite figures on speeds and feeds and depth of cut for specific materials are now available. This tabular data constitutes an important section of a new 52-page booklet entitled, "Haynes Stellite J-Metal Cutting Tools", just off the press. Another valuable section is a pictorial presentation of production jobs tooled with J-Metal. All in all the booklet gives the kind of information that the production man will want to have on tap. Ask us for a copy.

Standard Light

W. F. Bird, director of research, Collins & Aikman, had a very important message on automotive fabrics for body engineers and stylists at the April meeting of Detroit Section, SAE. His subject was much too wide in scope to permit of discussion here but several points were very impressive. They relate to SEEING color. Paint technologists will tell you that their biggest problem is to get paint inspectors to SEE color under some standard conditions; otherwise it is impossible to get acceptance. Upholstery people are up against the same situation—variability in the direction from which the light comes, variations in atmospheric conditions, reflections, amount of clouds, etc. Accordingly they recommend the use of a standard daylight lamp which, at least, will provide a uniform light source anywhere in the U. S. Another problem is that of color matching technique in which the inspector segregates the incoming materials into various gradations of shades. The experts recommend that the best and most economical practice would be to limit the number of such gradations for practical purposes.

All-Wheel Drive

Marmon-Herrington has a unique engineering and manufacturing operation. They go out of the way to tackle jobs that seem to have no rational solution when viewed through conventional glasses. Bread-and-butter business today is the all-wheel drive conversion for Ford truck chassis. And the latest wrinkle is an all-wheel conversion for the Ford passenger car chassis, using low pressure tires. Rural mail carriers are going for this job because it enables a man to cover any kind of territory in any kind of weather. Nothing can stop this mailman.

For Life

During the past year, applications of the Dardelet thread have grown by leaps and bounds on various machine elements and fastenings. The most important automotive application to date is its use on engine mounting bolts to secure the fastenings permanently.

Modern Finish

One of the important trends in passenger car finish is the use of heavier coatings to increase durability. While it has not been generally broadcast, it is a fact that during the past couple of seasons the lacquer has been formulated with a greater percentage of solids—and less thinner. However, the weathering characteristics of finishes still depend to a large extent upon the care given by the car owner. If car owners knew how much the life of the finish could be prolonged by proper care, there would be fewer headaches for the factory and the paint manufacturer.

Magnesium Welds

That Dowmetal can be welded readily, if the proper technique is used, is an established fact, according to George McCarroll, v.p., Sleeper Coaches, Inc., who use Dowmetal in the construction of their sleeper buses. Sleeper Coach experience indicates that the magnesium alloy not only may be spot-welded, but can be welded with the oxy-acetylene torch, without burning.

Surface Broach

During our travels recently we saw one of the largest vertical type surface broaching machines that we have encountered thus far. At the moment it is set up in experimental production, so that nothing more can be said. The machine is fitted with two huge slab-broaching rams for finishing the top and bottom surfaces of a cylinder block.

That's Progress

One of the big auto plants installed last season a large battery of unique welding machines for stitch-welding a sizable stainless steel plate. It took many months to develop the process and to get the machines operating properly. Then came an improvement in design. Now the machines will be taken off the job willy-nilly to make way for the new construction. Eternal change is the very essence of mass production.—J. G.

Foundry Layout

Pouring of molds is facilitated by the trolley-suspended ladles which move on the network of overhead rails.

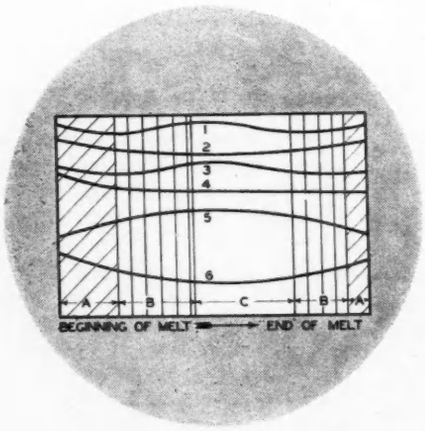
Portable molding machines are used to build up stacks of piston ring molds. This set-up achieves maximum flexibility since the operator can move up and down the line, making up the molds as he moves along

THE modern piston ring is a very complex and exacting element despite its rather simple appearance to the eye. When you put it to work, the performance of an expensive engine hangs in the balance. It is subject to flexure, repetitive stresses, high temperatures as well as reversals in heat stresses, and last but not least—to violent sliding action and abrasion.

Small wonder that the good piston ring is fussy as to its metal diet and the way it is prepared.

We believe that foundrymen and metallurgists in general will be interested in the new foundry of the Wilkening Mfg. Co., Philadelphia, because its layout, procedures, and equipment all were developed around the logical requirements of ring section as well as the variables encompassed in foundry melting practice.

It has been demonstrated that certain controlling properties of the metal, at least so far as piston rings are concerned, vary quite measurably during the different stages of a melt. Fortunately these variations follow a well-



Melting diagram. Rings of heavy cross section are cast in periods marked A; rings of average cross section in periods marked B and rings of difficult cross section in the period marked C. Curve 1, manganese — curve 2, silicon — curve 3, total carbon—curve 4, shrinkage and hardness—curve 5, fluidity, temperature, deflection, modulus of elasticity and rupture —curve 6, chill.

Facilitates Quality Control

Frequent sampling of each mix and effectual routine maintain Wilkening standard

By Joseph Geschelin

defined course under controlled conditions and consequently, can be turned to good advantage with the proper procedures. Refer to the melting diagram which is said to represent typical conditions in a well-managed cupola.

After the melting diagram for the two cupolas used in this foundry was obtained, it was put immediately to practical use. First, it was decided that rings of heavy cross-section would always be poured from material obtained in the region defined as "A"; rings of average cross-section, from region "B"; and rings of difficult or critical cross-section from region "C."

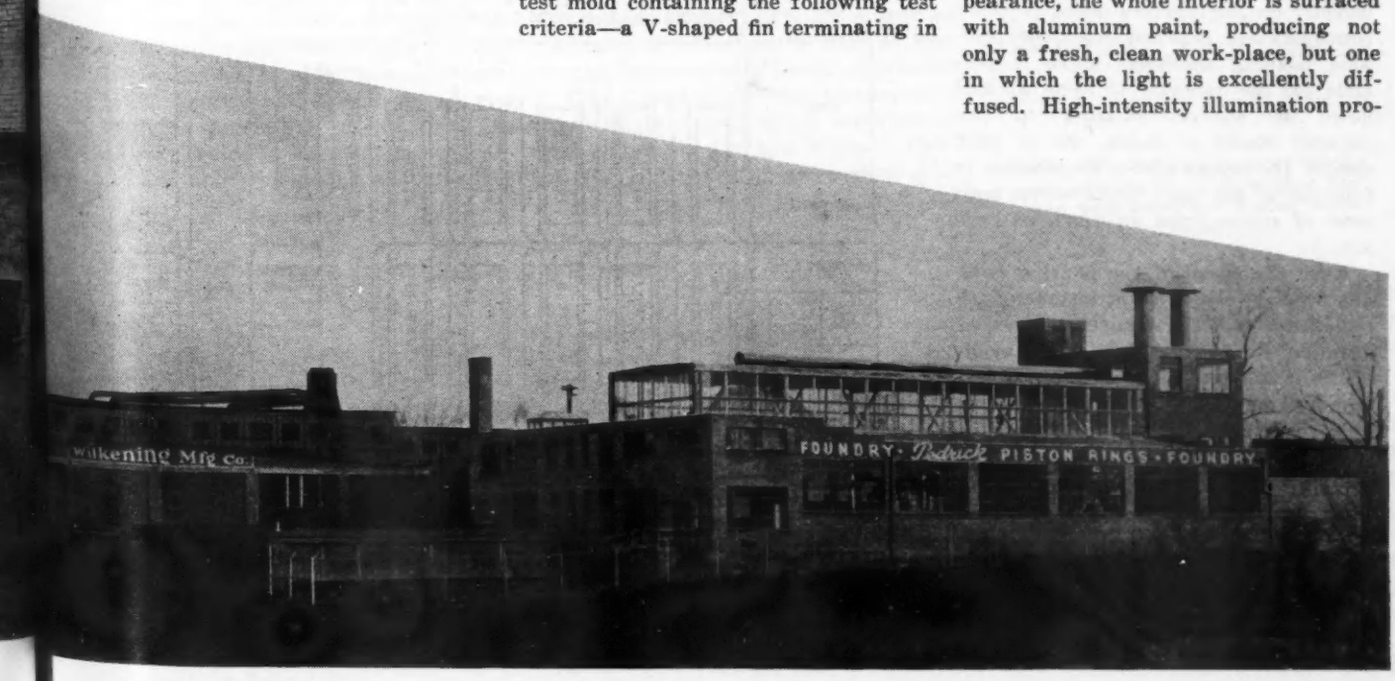
Insofar as rings of different cross-section depend upon the character of the metal, they respond in a like manner to variations in pouring temperature of the mix. And that immediately defines the floor plan. As shown in the diagram, the floor has been divided into regular areas for pouring different grades of rings. It is obvious that the location of any given area establishes its distance from the cupola and consequently modifies the temperature at which the metal may be poured.

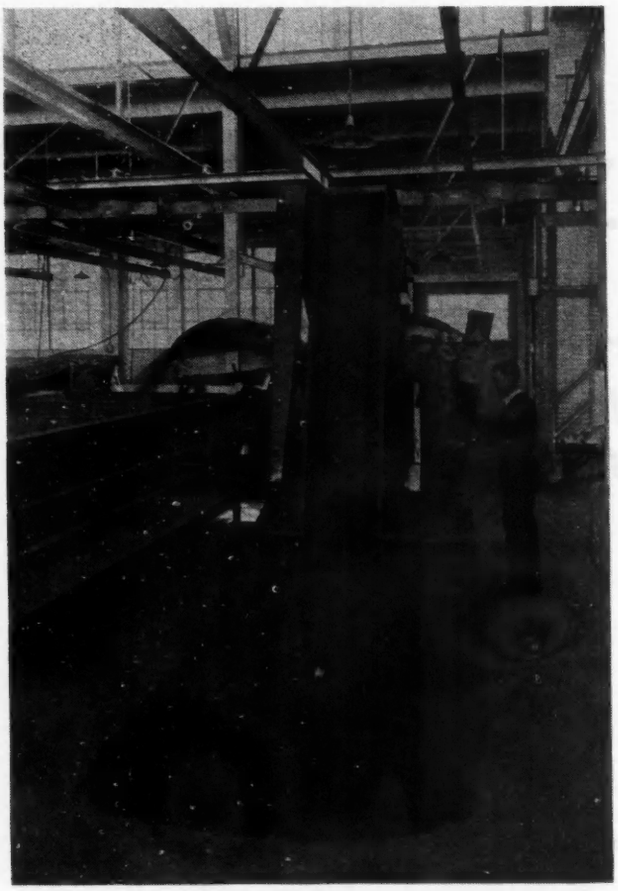
Examining the floor plan, we find that rings of most difficult cross-section are molded and poured on floors 1, 2, 6, and 7; rings of average cross-section are molded and poured on floors 3, 4, 8, and 9; while rings of heavy cross-section are molded and poured on floors 5 and 10. The pouring ladles traverse the entire floor on an overhead trolley system with switching stations which permit the ladle to move up and down the center of each floor area.

Since the whole process relies upon the melting curve, a rational procedure has been adopted for checking metal at frequent intervals during the working day. For this purpose, each of the two cupolas has an auxiliary vent for an inspector's use, from which samples are taken every 15 minutes. The sample is poured into a standard test mold containing the following test criteria—a V-shaped fin terminating in a sharp edge to indicate depth of chill; three rings representing the three average cross-sections designed to indicate the amount of shrinkage; and a special fluidity spiral.

The metal pattern was designed after considerable experimental work to provide the answers very quickly. An interesting feature is the fact that the location of the three rings with respect to the fluidity spiral is such that the fluidity reading automatically indicates the type of cross-section for which the metal is best suited.

So far as visual evidence goes, this plant is of simple outline with a nice disposition of window glass that floods its every corner with bright daylight. To further heighten its attractive appearance, the whole interior is surfaced with aluminum paint, producing not only a fresh, clean work-place, but one in which the light is excellently diffused. High-intensity illumination pro-





Portable sand conditioning machine combining functions of sand conditioning and bin loading is another element contributing to the flexibility of the new Wilkening foundry. Note the stream of conditioned sand directed into the storage bin.

vides a good source of artificial light.

Although every operation is completely mechanized, the whole scheme is surprisingly flexible. Each floor area is provided with a large metal bin for sand storage. The molds are made mechanically on portable molding machines built to Wilkening specifications and the molds are built up in stacks directly on the concrete floor. No floor conveyors are required since the portable molding machines make it possible for the operator to move up and down his station, building up two parallel stacks of molds, one on each side of the center aisle. The molder is followed by the ladle which serves both rows of stacks from an overhead trolley.

Even the detail of the pouring ladle has been developed in accordance with the metallurgical requirements. For example, due to the height of the mold-stacks it is essential to maintain a certain average head of metal to assure uniform quality. For this purpose, the ladle is spring-suspended in such fashion that, as the metal load is reduced, the springs automatically adjust the distance of the ladle upward above the molds, compensating by gravity for the depreciation in head. The ladle has two spouts to facilitate pouring on both sides of the fixed center.

Metal patterns have been designed scientifically to provide the best metal flow for the different types and sizes of rings. Thus we find patterns with only one ring impression for large rings; and gated patterns ranging from four to nine rings, depending upon diameter. The cross-section and size of the gates and sprues are also determined experimentally to produce the most favorable conditions.

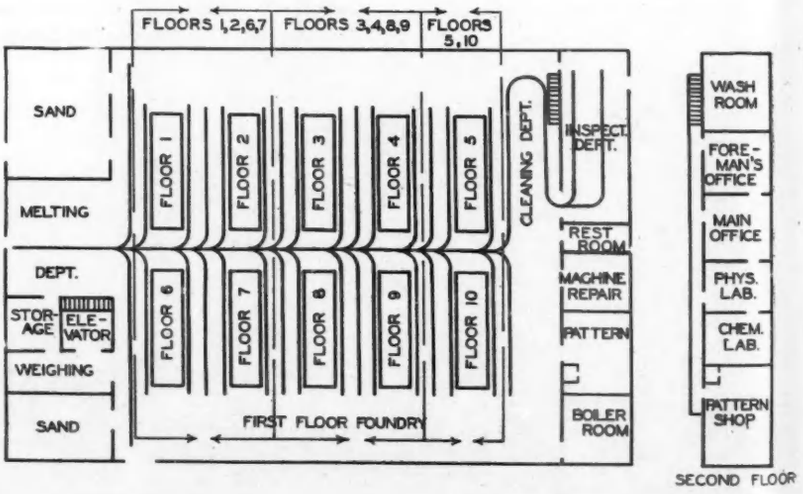
Scheduling of pouring lines is facilitated by using colored paddles to indicate the type of ring section made in each floor area. Scheduling starts with the inspector at the cupola. As he determines the type of metal which is tapped at various stages in the cupola, he flashes a suitably colored lamp mounted on a panel above the cupola station. This flashes a warning to all foundry executives, and at the same time instructs the pouring operator where to move his charge.

Sand conditioning has been worked out in a most unusual manner. Instead of following the usual practice which involves shake-out grates and pits under the floor, they encouraged the development of a novel, portable sand conditioning machine which handles all the detail automatically.

The cycle of events is about as follows—first the stacks of molds are built up, using conditioned sand stored in the bins; then comes the pouring of metal; and finally, the molds are shaken out directly onto the concrete floor. The burned sand then is mixed with definite proportions of good, tested sand and a definite amount of water is added to the dry mixture.

The portable, power-driven, sand conditioner then comes into action. First it picks up the sand piles on an endless bucket chain belt. The sand is

(*Turn to page 707, please*)



Floor plan of the Wilkening foundry. Floors 1, 2, 6 and 7 are devoted to the casting of rings having the most difficult cross sections. Castings for rings of average cross section are poured on floors 3, 4, 8 and 6. Rings of heavy cross section are cast on floors 5 and 10. This arrangement is tuned to the variables obtained during different stages of a melt.

SAE Summer Meeting Blankets Developments in the Industry

New testing and production techniques are described. Trends in design are shown. Some of the papers are abstracted here with more to follow in subsequent issues

Effect of Noise of Detonation on the Ear Is Measured

TESTS on the C.F.R. engine have shown that the cylinder is subjected to longitudinal strains which increase with the intensity of detonation. The strains are periodic, of course, hence the cylinder vibrates, and the mean velocity of its vibration has been found a reasonably accurate measure of the effect which the noise of detonation has on the ear.

The mean velocity of the vibration can be determined by securing an iron rod to the upper part of the cylinder and bringing its lower end within a few thousandths of an inch of the pole of a magnetic pick-up device secured to the water connection at the lower end. As the cylinder vibrates in the axial direction, the air gap between the iron rod and the magnetic core of the pick-up device varies, and a current is induced in the fine-wire winding of the pick-up which is directly proportional to the velocity with which the air gap changes. Leads are carried from the pick-up device to the grid of a rectifying and amplifying tube, and from the latter to a knockmeter. The instrument described, which was developed at the Sunbury Research Laboratories of the Anglo-Iranian Oil Co., Ltd., was described in a paper by E. S. L. Beale and R. Stansfield.

The instrument has no moving parts other than the pointer of the knockmeter. The components fitted to the engine can be installed in a few minutes; they are external to the cylinder and not subjected to the heat of combustion. Adjustments are not critical and change of air gap alters only the sensitivity, not the knock rating. Only one setting of the pick-up is required for the entire octane scale. The usual knockmeter (without the heater element) can be used. Knock-intensity determinations may be made by the method employed with the bouncing pin, critical adjustments, such as that of the bouncing pin, being eliminated.

Fig. 1 herewith shows the arrangement of the components mounted on the cylinder of the test engine. Pick-up unit *A* is screwed into a plate *B* of heavy section, carried from the flange of the water inlet connection *C*. Nut *D*, which locks the locker-arm support *E*, holds a slotted steel plate *F* into which a steel tube *G* is brazed or welded. The

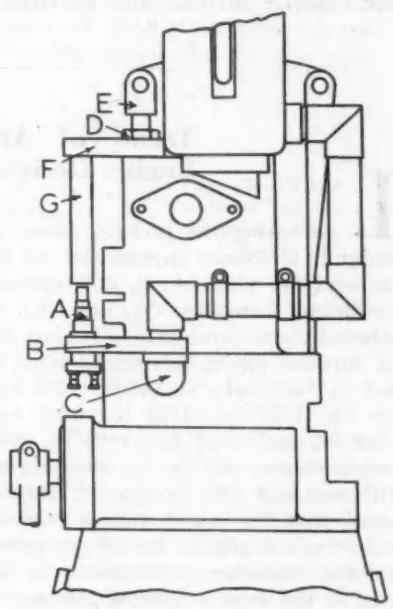


Fig. 1—Arrangement of pick-up unit on C. F. R. engine for use with Sunbury Knock indicator

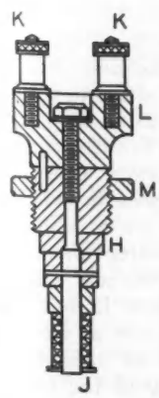
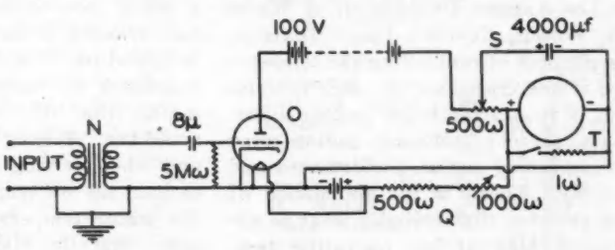


Fig. 2 (Left) Section of pick-up unit.

Fig. 3 (Below) Knock indicator amplifier unit, battery operated



lower end of the steel tube is fitted with a soft-iron disk, brazed or welded to close the end of the tube, and faced off. The pick-up (Fig. 2) is adjusted in the flange so that the air gap measures 0.004-0.006 in. after the engine has reached its normal working temperature. It consists of a permanent magnet into which a soft-iron pole *J* is pressed (and pinned). This pole is wound with 5000 turns of fine-gage wire, the ends of which are fastened to terminals *K* set in a bakelite cap *L*,

and the unit can be locked in its holder by lock nut *M*.

In a circuit arranged for battery operation (Fig. 3), leads from the pick-up unit are connected to the terminals of an input transformer *N* having a step-up ratio of 1:7, the secondary winding of which is coupled to the grid and cathode of a cumulative-grid rectifying tube *O*, a high-gain triode having an amplification factor of about 35 and a mutual conductance of 3000 mircromhos. The output from the anode circuit is taken through the usual knockmeter which is used without the heater element and acts as a direct-reading milli-ammeter giving a full-scale deflection with 1.8 milliamperes. Overloading the meter is avoided, and zero setting of the pointer is made possible by the use of a bucking circuit fed from the "A" battery and controlled through a fixed and a variable resistance as shown at *Q*. The knockmeter is arranged with a resistance with potentiometric connections in the positive lead. A variable proportion of this resistance and the meter are together shunted with an electrolytic condenser *S* of 4,000 μ capacity. Adjustment of the potentiometer control *R* enables any desired degree of damping to be obtained.

When the tube unit is first switched on, the bucking circuit tends to deflect the meter pointer of the scale, and to avoid this and prevent damage to the pointer, a 1-ohm resistance *T* is shunted across during the warming-up period.

As soon as emission is established, the pointer falls nearly to zero. A minute or so later it may be set exactly to zero by means of the zero setting resistance *Q*, so as to ensure that the pointer will remain on the scale when the 1-ohm shunt switch is opened. This switch is finally opened and the apparatus will operate at full sensitivity.

The settings described are made with the engine running at standard knock intensity obtained by running on 65 octane fuel at 5.3:1 compression ratio for Motor Method testing, and the pointer is then adjusted with the zero setting resistance to a 50 scale reading (half full scale).

Three different methods of use of the apparatus were fully described.

Trend of Air-Cooled Aircraft Engine Design in Next Five Years

IN discussing the probable trend of design in air-cooled aircraft engines for the next five years, A. H. R. Fedden of the Bristol Aeroplane Co., Ltd., said he believed the requirements in engines for all purposes during this period could be met by four sizes, as follows: 750 hp., 820 lb.; 1150 hp., 1250 lb.; 1550 hp., 1550 lb., and 2000 hp., 2100 lb. The weight figures are for the bare engine with standard fixed equipment. He believes that the trend will be toward multi-engined planes for all purposes, and the following conclusions with regard to the most promising layouts of engines are based on this assumption.

As aircraft design and manufacturing technique advance, the total drag of aircraft will approach more closely to the ideal—that due to turbulent skin friction. Approach to this ideal will engender a trend to submerge power units entirely within the envelop of the wing. However, such fundamental changes in the layout of all four suggested sizes of powerplant as this implies can hardly be accomplished within the period under review, and most probably it will never be required, since, in the larger classes, where four or more engines will be the equipment of one ship, the wing thickness will be such as to permit of radial engines being housed inside the leading edge.

Full-scale research must be undertaken in regard to the position of the propellers on the leading edge of the wing, the effect on the wing and spar designs of accommodating the engines accessibly, and dealing with the stowage of undercarriages, and a host of other fundamental problems.

Drastic changes of this sort must come, and must be investigated on one type first, as in the case of the classic Douglass series, and the placing of the engine inside the envelop probably will come first in the smallest category.

Mr. Fedden said that in his opinion the four types of engines envisaged would have the following respective applications: The 720-hp. is suitable for twin-engined civil and military aircraft (destroyer and multiplane fighter types). He thinks there is justification for the serious consideration of a flat engine entirely buried in the envelop of the wing for these types of aircraft. The Bristol Co. some 18 months ago produced a layout for such an engine, but urgency of other work caused it to be side-tracked. If a sufficiently bold and specialized step can be justified—for military purposes for the highest speeds—this is the ideal solution for the future, for the smallest category of engine.

For more general use and for civil types the radial engine is the ideal form in this category.

It would appear, therefore, that two types of engine will have to be envisaged for this category: The radial engine in compact form, and the specialized flat engine. Sacrifices in regard to weight, cost, simplicity, etc., will have to be made on account of the flat engine, and many problems in regard to installation carefully investigated.

For the other three categories Mr. Fedden firmly believes that the radial engine will hold its own during the period under review. For the sizes and speeds of aircraft for which these engines are intended, it has been demonstrated that it will be possible to achieve even lower-drag installations than at present in vogue, by retracting the radial type of engine toward the leading edge of the wing, in conjunction with duct cooling. It would appear that the smaller the size of the aircraft, the more difficult it is to obtain a suitably scaled radial or in-line engine of sufficient power. The larger the size of airplane, the less can be said against the radial; in fact, in the largest category the engine is almost entirely lost in the wing section.

Crankcase Oil-Temperature Control for Better Lubrication

A PAPER on Crankcase Oil-Temperature Control was presented by E. W. Templin, automotive engineer of the Los Angeles Department of Water and Power, General Plant Division. The purpose of controlling the temperature of the crankcase oil, Mr. Templin said, is to provide better engine lubrication, thereby reducing engine wear and improving engine performance and economy. There is an abundance of data showing that cylinder wear is abnormally high at low operating temperatures, hence it is desirable to bring the engine up to its normal operating temperature as quickly as possible after a start from cold. When the engine has reached a satisfactory operating temperature it is desirable to hold the crankcase oil temperature at approximately that of the cooling water, to avoid the "oil drag" of the cold engine; and when driving hard, it is desirable to hold the oil temperature as close to the water temperature as possible, in order that the viscosity of the crank-

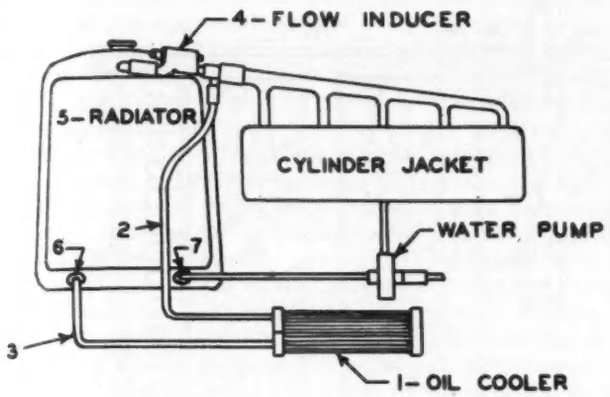


Fig. 1 — Diagram of Hild Multiflow oil temperature regulating system

case oil may not become dangerously low. In addition, many lubricating oils develop injurious products of oxidation at temperatures above 250 deg. Fahr., which attack cadmium-silver and copper-lead bearings and tend to cause piston rings and valve stems to stick. Many refiners are now adding anti-oxidation elements to their oils to prevent these chemical changes, but these protected oils are expensive and are not generally available.

A multiflow system of water- and oil-temperature control has been invented by F. W. Hild of Los Angeles and was described by Mr. Templin in his paper. The system is shown diagrammatically in Figs. 1 and 2. It comprises a small radiator of the fin-and-tube type installed in the sump of the engine, the oil returning to the sump coming in contact with the external surfaces of the radiator. A separate water circuit is provided, and water flow is induced through the oil radiator by the "flow inducer" of which a detail view is shown in Fig. 2. From one side of the lower tank of the main radiator the water passes through the oil radiator to the engine outlet, into the "flow inducer," and thence to the top of the main radiator with the rest of the circulating water.

With this control installed on a six-cylinder automobile, tests were run with the rear wheels jacked up, and the results are plotted in Fig. 3, full lines showing results with the single-flow and dotted lines those with the multiflow system. It will be seen that after four hours' running with the standard single-flow system, the crankcase oil has attained a temperature of 220 deg. Fahr., and apparently it would have continued to rise if operation had been continued. With the multiflow system, on the other hand, the oil temperature became stabilized at 181 deg. Fahr., after four hours' running.

In comparative tests of this six-cylinder car with the multiflow system installed, and an eight-cylinder 1931 model of the same make and equipped with a standard oil cooler, the oil temperature of the former became stable at 165 deg. Fahr. after four hours of running, while that of the latter became stable at 214 deg. Fahr. in the same time. The cooling element of the six-cylinder car (multiflow system) had a radiating surface of 1532 sq. in., whereas the one on the eight-cylinder had only 400 sq. in., which may explain the difference in the crankcase temperatures.

A multiflow system was installed in a 10-ton tank truck hauling a nominal gross load (gasoline) of 68,000 lb. from Los Angeles to Phoenix, Ariz. There was one difference between this installation and that previously discussed, namely, an addition to the water radiator, which was considered necessary to take care of the additional heat absorbed in the oil cooler. Tests by Robert W. Beal indicated that about 3½ per cent of the total heat units supplied to the engine can be dissipated in an oil cooler. Oil temperatures reached peak values at the summit of Telegraph Pass Grade, where the crankcase oil reached 230 deg. Fahr. without the oil cooler and 203 deg. with it.

Combination Oil Cooler and Temperature Regulator

A combination of a full-flow oil filter and an oil-temperature regulator (Fig. 4) has been developed by a Los Angeles engineering firm. The filter system consists of two disk-type automatic cleaning filters in tandem and two "polishing" filters in parallel, all enclosed in the inner case, with provision for removal and cleaning. The temperature-regulator radiating surface consists of the external face of the inner case and a single coil of 50 ft. of ½-in. o.d. copper tubing surrounded by the water jacket. The engine cooling water circulates through this jacket, entering at one side, passing all the way around, and leaving at the other. The cooling surface amounts to 1375 sq. in.

The designer plans to place the regulator in the discharge line of the water pump. If the car does not already have a thermostat and bypass, he will install

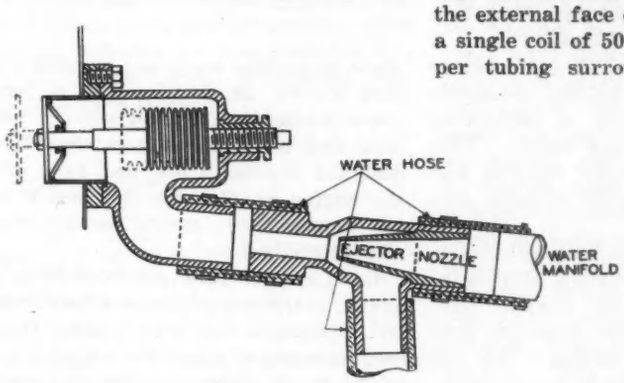


Fig. 2—"Flow inducer" as installed on 1931 Buick

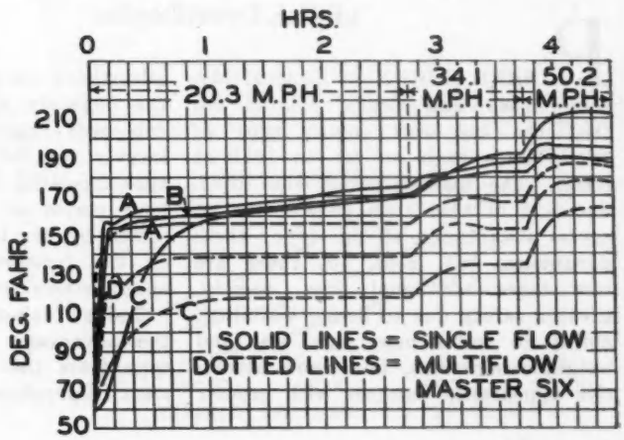


Fig. 3 — Results of run with car stationary — Solid lines, single flow; dotted lines, multiflow. Temperatures: A, rear end of water manifold; B, outlet of water manifold; C, crankcase oil; D, water at "flow inducer"

these units. The advantages claimed for this combination are as follows: High oil velocity through coil, aiding in the heat transfer and scouring the inner surface; minimum tendency for insulating film to form on heat-transfer surface; little chance of water getting into the oil; space economy due to the combination of the two elements, and the safety feature by which, when there is excessive resistance to oil flow, oil is delivered to the engine directly through the spring-loaded bypass valve B.

Mr. Templin recommended that all heavy-duty units be equipped with crankcase-oil-temperature gages on the dashboard. These gages should be accurate and should have marked on them the critical dangerous temperatures for various S.A.E.-viscosity-number oils. The driver can then prevent trouble by merely seeing to it that these temperatures are not reached or not exceeded. The author said he considered these gages even more important than cooling-water thermometers.

Some of the conclusions drawn from the data presented in Mr. Templin's lengthy paper are as follows:

Complete crankcase oil temperature control would effect definite economies in operation, especially by permitting lighter oils to be used safely. This would allow satisfactory starting and prevent low-temperature cylinder corrosion.

The lower maximum temperatures of circulating oil would have a definite influence in lowering the internal temperatures of the engine, especially that of the bearings and pistons. The life of these and related parts would thereby be prolonged.

By operating the lighter oils at a controlled maximum temperature, film rupture and oil decomposition would be avoided. This would result in materially reduced engine wear.

Many creditable efforts have been made to provide crankcase oil temperature control units. However, a complete mechanism for control of both high and low temperatures should be designed especially for, and built into the engine, so that the full benefit of oil temperature control possibilities may be realized.

Until engine designers provide adequate crankcase-oil-temperature control, operators may well protect their engines against excessive temperature by the use of crankcase-oil-temperature indicators.

By the use of engines provided with adequate-oil-temperature control, S.A.E. 20 or 30 oil could be used almost universally year in and year out, with a reduction in engine wear and an improvement in engine performance.

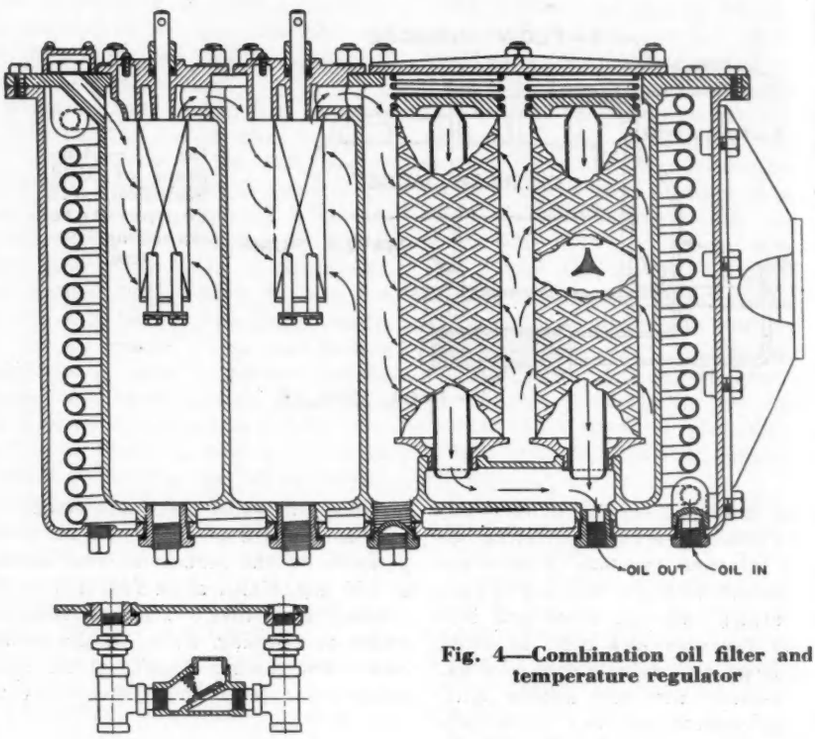


Fig. 4—Combination oil filter and temperature regulator

The New and Old Design of Cab-Over-Engine

PIERRE SCHON of General Motors Truck and Coach pointed out that the cab-over-engine type of truck dates back as far as 1911 at least. The manufacturer who introduced it at that time gave a list of seven advantages of the type; these advantages still hold, but there are now three additional ones, namely, greater safety due to better visibility; ability to better meet legal size and weight restrictions, and more attractive appearance together with greater advertising value. Mr. Schon thought the ungainly appearance of the first cab-over-engine design accounted largely for the disappearance of the type from the American market for a long period of years, its fate being sealed by the ban of the Government on the forwardly-located cab in its specifications for war equipment.

Today's cab-over-engine trucks have the advantage over the conventional type from the standpoint of appearance. Operators throughout the country are conscious of the advertising value of a vehicle which attracts attention, and no single development in truck design during the last 25 years can compare with the advertising value incorporated in these streamlined 1937 products.

The advantages of the c.o.e. design are pronounced wherever the type of commodity hauled requires maximum loading space, as in the "truckaway haul" of new cars from the automobile factories. In this line of transportation the economical load is four cars, and the minimum load length for the semi-trailer itself is 33 ft., making the total minimum overall length of the tractor and trailer 40 ft. Fourteen states have enacted laws allowing less than 40 ft. for this combination, and various contrivances have been built to permit of carrying sufficient passenger cars for profitable operation. If only three can be carried, it means a reduction of 25 percent in the revenue per trip. Almost all replacement of equipment in this particular line of transportation is now of the c.o.e. type.

In the state of Illinois, where the length limit for a tractor and trailer combination is 40 ft., the c.o.e. design makes it possible (in the transportation of milk, for instance) to use a six-wheel truck, load it to the legal limit of 40,000 lb., and attach a four-wheel trailer with a legal gross weight of 32,000 lb., giving a total gross weight of 72,000 lb.

While the c.o.e. truck costs more than the conventional vehicle, the slightly higher original cost is more than offset by its greater utility value. Aside from

the angle of legal restrictions, the c.o.e. truck has the two advantages of more load space and more payload capacity, the latter resulting in the main from a better distribution of load on the tires. A large department store in Chicago three years ago installed a fleet of eight c.o.e. tractors and 27 semi-trailers. The c.o.e. tractor made it possible to replace the 16-ft. semi-trailers previously used with 22-ft. semi-trailers.

Drivers experienced in the operation of conventional-style trucks, when placed in charge of one of the new type, invariably become boosters of the c.o.e. design with its easier handling characteristics and shorter turning radius.

The various operating advantages of the c.o.e. type in heavy traffic played an important part in the formulation of specifications for 315 new garbage-collection trucks, recently installed by the New York City Sanitation Department. The specially designed chassis is equipped with a 24 cu. yd. body, indicating that maximum obtainable load space was one of the deciding factors in favor of the c.o.e. type. The shorter, and therefore sturdier frame, is highly important in the dumping operation of this huge body. In this particular operation, where heavy traffic congestion is a serious problem, the conventional truck has definitely lost its place.

In bus transportation, the operator's demand for additional seating capacity has already obsoleted the "engine-under-the-hood" type of design. In the process of style change, during recent years, the first departure from the so-called conventional design was to place the driver's seat in a forward location, alongside of the engine. However, bus design has advanced a step further and now locates the complete powerplant at the extreme rear end of the vehicle.

Rear mounting of powerplants is impractical in the hauling of merchandise, and particularly in tractors and dump trucks. On the other hand the c.o.e. principle can be used to advantage for any and all vocational applications. Up to recently the c.o.e. type was handicapped by the limited demand and excessively high extra cost as compared with the conventional type. However, several of the larger manufacturers now offer a complete line of c.o.e. trucks, ranging from 1½-ton models up to the largest capacities allowed by State laws, and owing to larger production, these modern vehicles are now available at a much smaller price differential over conventional trucks.

Oiliness—What It Is and What It Means

"OILINESS" is a relatively new term which has been extensively used in discussions of phenomena of lubrication in recent years. Herschell has defined it as "the property that causes a difference in the friction when two lubricants of the same viscosity at the temperature of the film are used under identical conditions." There has been considerable difference of opinion as to the significance of the term, and some have even denied the need for this new concept. Prof. Everett of The Pennsylvania State College now seeks to explain the phenomenon which led to the introduction of the term by the influence of pressure on the viscosity of lubricating oils. It is well known that the viscosity decreases with an increase in temperature, but it is less well known that there is a pronounced increase in the viscosity with increase in pressure, and, as in the case of temperature, the rate of change in the viscosity with the pressure varies according to the origin of the oil. The title of Professor Everett's paper was "High-Pressure Viscosity as an Explanation of Apparent Oiliness."

In the experimental work on which the paper was based, use was made of a machine developed by Professor L. J. Bradford of Penn State, and which is illustrated by the diagram Fig. 1. It consists essentially of a small fitted brass bearing *B* supported on a knife edge and pressed upward against a journal *A*. The bearing is free to tilt, so that the necessary wedge-shaped film can be formed and may be loaded as desired. Just below the surface of the bearing is located a thermo-couple, while another thermo-couple is located outside the bearing in the oil stream *C*. These couples give temperatures approximating those existing in the oil film within the bearing and in the oil prior to entering the bearing.

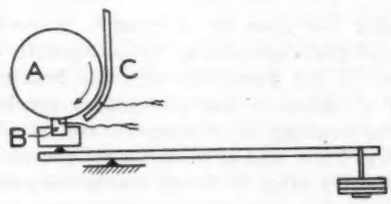


Fig. 1—Sketch of Bradford lubricant testing machine.

The journal is rotated at a constant speed of 465 r.p.m. and the bearing load is increased in steps of 500 lb. The difference in temperature between that of the entering oil and that of the thermo-couple junction bedded in the bearing is taken as a measure of the work done within the bearing. Accordingly, the graph of this temperature difference ΔT vs. bearing load establishes the relationship between the internal friction of the oil film and the bearing load. Provided the surfaces are accurately fitted to each other and of extreme smoothness, no difficulty is experienced in obtaining mean bearing loads up to 30,000 lb. per sq. in., and repetitive results can be readily obtained.

When matched as to viscosity, oils from the same crude but of different blends give practically the same bearing load-temperature rise curve. However, oils produced from crudes from different fields give decidedly different curves. This is shown in Fig. 2, which represents the results on three different oils, all matched as to viscosity at 130 deg. Fahr. but from Western, Mid-Continent, and Eastern crudes respectively. A.S.T.M. viscosity-temperature graphs of the three oils were reproduced in the paper, and from these it was plain that at bearing temperature the viscosity of the oil

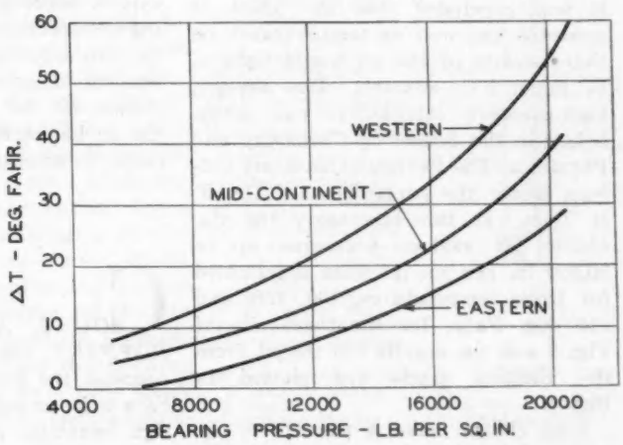


Fig. 2—Bearing load-temperature-rise curves for three types of lubricating oil.

from the Western crude would be materially lower than that of either of the other two.

According to orthodox theory, the friction between two parallel surfaces varies in accordance with the equation

$$\text{Resistance} = \text{Area} \times \frac{\text{Velocity} \times \text{Viscosity}}{\text{Film Thickness}}$$

For a wedge-shaped oil film the expression is more complicated, and recourse, therefore, was had to experiment to determine the effect of a change in viscosity alone on the temperature rise. Tests on various oils from Eastern crudes, all of the same viscosity index, at a mean pressure of 20,000 lb. per sq. in., showed that the temperature rise increases with the initial viscosity at 130 deg. Fahr. and atmospheric pressure (from 24 deg. Fahr. for 20 centipoises, to 41 deg. at 100 centipoises to 45 deg. at 140 centipoises, to 50 deg. at 200 centipoises). From this it is apparent that the higher viscosities give larger values of temperature rise. In view of the experimental fact that the temperature rise increases with the viscosity it was concluded that the effect of pressure (as well as temperature) on the viscosity of the oil would have to be taken into account. Therefore, a high-pressure laboratory was established in the School of Chemistry and Physics at The Pennsylvania State College, under the supervision of Dr. R. B. Dow. In this laboratory the viscosities at various pressures up to 50,000 lb. per sq. in. were determined for three temperatures, 100, 130, and 210 deg. Fahr. for the three oils of Fig. 2 and the results for the oil from the Eastern crude are plotted in Fig. 3.

Such charts make it possible to obtain an idea of successive viscosity changes experienced by a particle of oil on its travel through the bearing. For instance, the oil droplet reaches the bearing at a temperature of 130 deg. Fahr. and at atmospheric pressure. Shortly after it enters the bearing the pressure rises to the maximum, and this is accompanied by a corresponding temperature rise. As it approaches the exit edge, the pressure grows less, but the temperature continues to increase all the way to the edge. As the oil leaves the bearing the pressure drops to atmospheric.

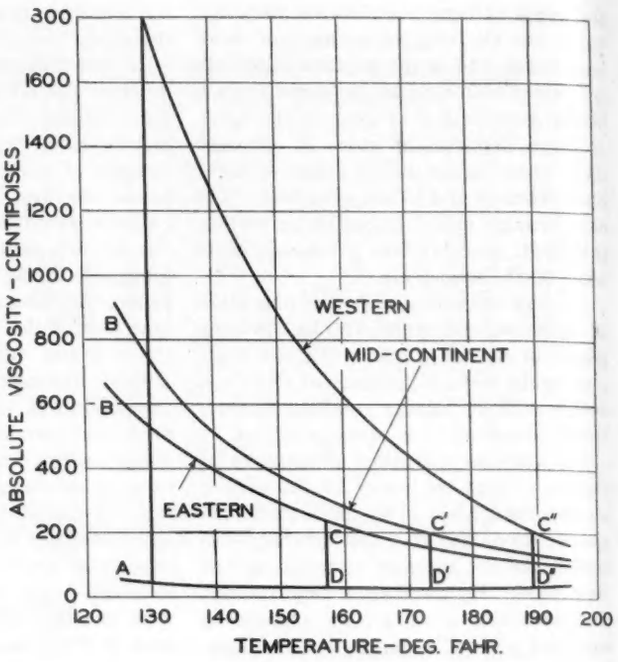


Fig. 4 — Simplified viscosity cycles for three types of oil (all for loads of 20,000 lb. per sq. in.).

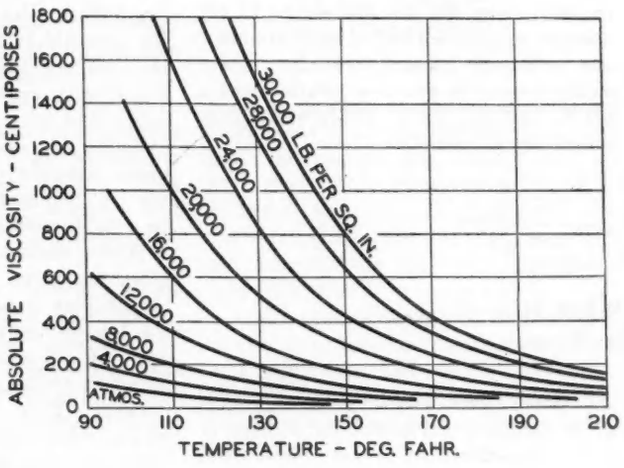


Fig. 3—Variation of viscosity of oil from Eastern crude with temperature and load (pressure).

Unfortunately, the exact manner of variation of pressure and temperature throughout the bearing film is unknown, and simplifying assumptions must be made. If it is assumed that the pressure is uniform throughout the bearing (and therefore equal to the mean), the pressure and viscosity of the oil as it enters the bearing rise immediately, the pressure to the mean value of 20,000 lb. per sq. in.; thereafter the pressure remains constant, but the temperature continues to increase, and as a result the viscosity drops until the exit is reached. This gives a temperature-viscosity cycle very much the same in appearance as a theoretical pressure-volume diagram of a gasoline engine with the compression line missing.

In Fig. 4 such simplified diagrams for the three oils under consideration are shown superposed. It is interesting to note that while the terminal viscosities (at C, C′ and C″) are not greatly different, the viscosities experienced in transit differ enormously. For instance, the particle of the Eastern oil reaches a maximum viscosity (at B) of approximately 525 centipoises; the Mid-Continent (at B′) of 740 centipoises, and the Western oil (at B″) of 1830 centipoises.

Public Calls for Body Design that Suggests Speed

COUNT ALEXIS DE SAKHNOFFSKY, the industrial stylist, propounded the thesis that one does not have to be an aerodynamic expert to design beautiful salable cars. He holds that what the public wants is not really the high speeds made possible by scientific streamlining but the suggestion of speed that charms the eye. There is a good deal of the grown-up boy in the

average purchaser, and in substantiation of this point the author cited an observation often made by him in his travels. When a crack sleeper train pulls into a station and the passengers alight, some of them always can be seen casting a shy glance at the locomotive as they pass by. They turn away as though ashamed of their childish interest in the locomotive. In reality there is nothing childish about this interest, said the author. It is very human to be sensitive to mechanical beauty; there is such a thing, and it is particularly applicable to the locomotive.

A lot of designers claim, said M. de Sakhnoffsky, that an educated man finds beautiful the products which are strictly designed for their function, but he held that many, besides being educated, are consciously or unconsciously attracted by sheer beauty. Besides, the numerous woman prospects must be considered, with whom eye appeal is a much more potent argument than a lengthy explanation that the car, though ugly, performs well.

The author pointed out that recent developments in car design have not been in line with the dictates of wind-tunnel results. The wind tunnel dictates a broad front, and never in the history of the automobile have radiators been narrower than in the last couple of years, some designers having gone to such extremes as to actually affect proper cooling. The wind tunnel wants a stubby front—the designers successfully introduce artificially long hoods. The wind tunnel suggests a vertical, rounded windshield—production cars have their windshields slanted at a sharper angle every year. These are just a few striking examples, chosen at random, to prove that streamlining is ruling the scales from the artistic angle.

The author said he was often asked whether his styling did not interfere with the proper performance of the cars he designed; his answer was that it did not, that, on the contrary, the improved performance, which was entirely incidental, often more than justified the expense, and to substantiate this point he submitted a letter from a Canadian firm of brewers for whom he designed a number of big tractors that drew universal attention.

Springless Bouncing Pin Knockmeter Described

ACCURATE maintenance of standards of antiknock value is a matter of great importance to the refiner, and laboratory apparatus and testing procedures which increase the accuracy of ratings are therefore desirable. Earl Bartholomew and Cleveland Walcutt of the Ethyl Gasoline Corporation in a paper prepared by them described a new springless bouncing pin indicator for which they claimed the advantages of elimination of the secondary bounce of the pin (which reduces the number of electrical contacts per explosion), improved electrical contact, long life of points, high degree of stability in operation, maximum sensivity, and ease of adjustment.

It is well known that antiknock ratings of fuels made in different laboratories often do not check well, and at present there are four variables which account for this lack of agreement, viz., carbon accumulation, atmospheric humidity, bouncing-pin adjustment and knock intensity. The new bouncing-pin indicator is said to offer the possibility of considerably better control over the last two of these.

A drawing of the modified indicator, partly in section, is reproduced herewith. The instrument incorporates the regular diaphragm *M* and a modified pin *L*, the lower end of which is separated from the diaphragm by a gap and the upper end of which has a shoulder which rests on the threaded and graduated head *Q*. The gap between bouncing pin and diaphragm may be varied by rotation of the head, which may be locked by screw *R*.

The lower contact point is mounted on the upper end of the bouncing pin assembly, but insulated from the body of the pin. The upper contact point is free to move vertically within limits in bracket *F*, which is rigidly attached to spindle *E* of a standard micrometer. The micrometer sleeve *D* is rigidly attached to the upper frame *U*. As the micrometer thimble *A* is turned, the gap between the contact points is increased or decreased, and the adjustment may be locked by screw *B*.

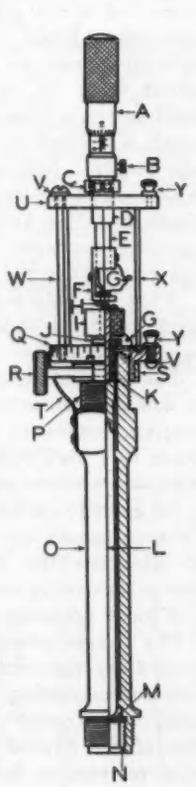
Deflection of the diaphragm due to the pressure of detonation causes it to close the gap between pin and diaphragm and project the pin upward. The period of closure of the contact points is a function of the height to which the pin is projected. Since the only force resisting the motion of the pin is the negligible weight of the upper contact point, its motion should approximate that of a freely projected body. A curve of position of the pin versus time, determined by allowing the contact of the points to discharge a condenser into the neon tube spark protractor on the C.F.R. engine crankshaft, shows a negligible deviation from the theoretical curve.

Attached to the upper end of the bouncing pin assembly and immediately under the lower contact point is a coil of magnet wire which is connected in series with the contact points. At the initial contact of the points, current flows through the points and the coil of wire, holding the cobalt points in firm contact until the circuit is broken by the falling pin. The contact points are enclosed in a glass housing *X*.

If the gap between the lower end of the pin and the diaphragm is progressively increased, a point is reached where the diaphragm no longer contacts the pin. If the gap between the contact points is simultaneously reduced, experiment has shown that the indicator continues to give a sensitive and stable indication of knock intensity. Although the movement of the cylinder may account partially for the movement of the pin under normal conditions, under the conditions just described it is entirely responsible. The author said it had been shown that an indicator of this type can easily be adjusted to give an indication of knock intensity more nearly approaching that of the ear than the indication of the conventional instrument.

Assembly Drawing of Springless Bouncing Pin Indicator

A. Micrometer Thimble (for adjusting gap between contact points)
B. Micrometer Thimble Lock Screw
C. Split Micrometer Retaining Collar
D. Micrometer Sleeve
E. Micrometer Spindle
F. Bracket Holding Upper Contact Point
G. Flexible Conductors
H. Cobalt Contact Points
I. Magnetic Holding Coil
J. Shoulder for Holding Bouncing Pin Off Diaphragm
K. Fiber Insert in Bouncing Pin
L. Bouncing Pin
M. Diaphragm
N. Diaphragm Lock Screw
O. Bouncing Pin Body
P. Threaded Upper End of Bouncing Pin Body (40 per inch)
Q. Graduated Head (for Adjusting Gap Between Diaphragm and Lower End of Bouncing Pin)
R. Graduated Head Clamp Locking Screw
S. Graduated Head Locking Clamp
T. Pointer
U. Upper Frame
V. Insulating
W. Studs
X. Glass Housing
Y. Binding Posts



The Production of Hypoid Gears with High Standard for Accuracy

HYPOID gears are now being produced to a higher degree of accuracy than it has been possible heretofore to produce any type of axle-driving gears, said W. A. Witham of the Gleason Works in a paper on Hypoid Gears, Axles, and Lubricants. The introduction of the single-cycle method of cutting Formate or non-generated gears probably has been the most noteworthy advance in this direction.

Formate gears differ from generated gears primarily in the amount of profile curvature. In a generated set, correct conjugate tooth action is obtained by making the profiles of both the gear and pinion substantially involute. The Formate gear profile is made straight, being formed by a cutter having straight blades. The pinion is generated to be correctly conjugate to this type of gear. The actual difference in profile shape between a generated gear and Formate gear of say 10 in. diameter and 40-deg. spiral angle is only 0.003-0.005 in.

At present the Formate gear is displacing all other types in quantity production, because it can be produced both more accurately and more rapidly. In cutting these gears, the feed is imparted to the cutter by setting each successive blade radially beyond the preceding one so that each removes about 0.001 in. of stock. A feeding mechanism is thus dispensed with. One tooth is finished with each revolution of the cutter. Indexing is accomplished while a gap between the last finishing blade and the first roughing blade is opposite the gear face, without withdrawing either the cutter or the work.

Thus the only motion in the machine while the tooth is being cut is the rotation of the cutter.

The greater rigidity of this machine, in combination with the single-cycle of cutting, makes it possible to produce gears to a high degree of precision and with an excellent surface finish.

In quantity production, the teeth of Formate gears are also being ground, to eliminate the effects of distortion due to hardening and for a better finish and more accurate tooth spacing.

The hypoid pinion is finish cut in a generating machine, in an offset position corresponding to its offset in the axle. The cutter represents a tooth side of the hypoid gear and the same relative motion is imparted between the cutter and the pinion to be cut as exists between the finished gear and pinion. With the adjustments provided on this machine, tooth surfaces can be produced that match those of the mating gear along their entire length and across the whole depth of their profiles. However, for adjustability, that is, to provide a certain range of running positions allowing for a non-rigid axle mounting, the bearing area is somewhat reduced. Any desired deviation from a full conjugate bearing can be obtained lengthwise or on the profile.

Thus, in the generation of the pinion, the tooth bearing characteristics, including length, width and general shape of the contact area, are under complete control. The most desirable characteristics of the tooth bearing are obtained by determining axle deflections and observing the movement of the tooth bearing under appropriate loads. These data are then correlated with results obtained by running the gears in a rigid testing machine and are applied to the development of the finish-cut pinion.

Lapping is now the universal surface-finishing method, and the lapping action is faster in the hypoid than in the spiral bevel gear, because of the greater amount of sliding motion in the former.

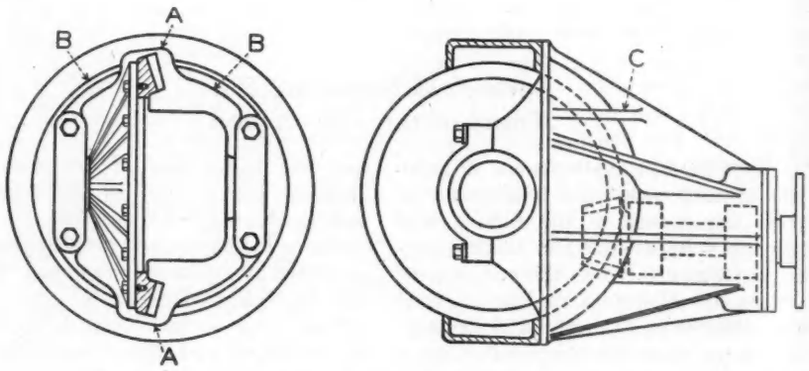
On account of the offset, the profiles of opposite sides of pinion teeth are not symmetrical, the concave side usually having a flatter profile than the convex side. In order to maintain approximately the same conditions of tooth contact (equal arcs of action and duration of contact, similar relative radii of curvatures of the tooth profiles, and equal freedom from undercut on the two sides), the pressure angles of the two sides are made unequal (17½ deg. for the driving side, 25 deg. for the coasting side).

In the selection of the spiral angle a number of factors require consideration. Any increase in this angle gives a greater number of teeth in contact and an increase in the pinion diameter, but also an increase in the axial thrust and in the normal tooth load. It has been found that the load capacity increases faster than the axial thrust. The best balance between these various factors seems to be obtained with a pinion spiral angle of 50 deg., which for an average automotive hypoid gives a gear spiral angle of 25 deg.

Owing to the smaller spiral angle of the hypoid gear, the normal tooth load is substantially less than with a spiral bevel gear of the same diameter under the same torque. Gleason Works recommends a limiting tooth load of 1600 lb. per inch of gear-face length in direct drive, and 4200 lb. in low gear. Hypoid gears are particularly suited for use in high-reduction truck axles, where the larger diameter of the hypoid pinion gives a very considerable increase in tooth strength. For such applications the offset should not exceed one-eighth of the gear diameter.

The more rigid the gear mountings, the greater the length of tooth contact that can be used, and the lower the resulting surface stress. Very flexible mountings require a short tooth bearing located close to the toe under light loads, in order to prevent excessive concentration of load at the large end under heavy loads.

It is not possible to accurately predict the behavior of gears in an axle, from a visual or mathematical study of the axle. The only satisfactory method is to study the actual method of tooth bearing under progressively increased load, to amplify such a study with actual measurements of deflections of the various axle members, and to cor-



Ribbing on differential carrier to assure the necessary rigidity

relate such data with displacement checks in a rigid testing machine. Pinions should not deflect more than 0.003 in. axially, vertically, or transversely. The displacement of the gear in the vertical direction and in the direction of the pinion axis should not exceed 0.003 in., while its movement away from the pinion should not exceed 0.010 in. These limits necessitate bearings of ample size, properly supported, and gear and pinion mountings rigidly tied together. Internal yield of the pinion bearings can be reduced in most types by preloading, and in straight roller bearings, where this is not practical, the radial freedom must be limited to 0.0004 in. Differential side bearings of either the ball or taper roller type must be preloaded. Preloading is necessary to keep the relative displacement of gear and pinion within proper limits.

Rigidity of the bearing supports must be secured by suitable ribbing on the body of the carrier, and the drawing herewith shows a few types of ribbing that have been found quite effective. Large vertical ribs greatly increase the resistance to vertical pinion displacement. The cut-away portion at *A* should be reinforced to prevent excessive distortion of the back flange. Gusset ribs *B* extending in toward the gear as closely as possible are effective in distributing the loads between the two pedestals. The horizontal rib at *C* is often used to increase the rigidity of the pedestals and carrier flange. By offsetting the gears transversely with relation to the housing, the load distribution between the two pedestals is improved, adequate space is obtained for proper gear backing, and the differential-case flange is of ample thickness and the proper proportion to resist bending.

Fracture of gear teeth (usually of the pinion) in service has been found to be due to fatigue. Tests of the fatigue life of spiral bevel and hypoid gears subjected to the maximum engine torque through the low gear, and a correlation of the results with the service records of a number of car manufacturers have led to the conclusion that a spiral-bevel axle that will withstand 200,000 cycles of the pinion under maximum engine torque through low gear in the laboratory test will give consistently good service in the field. Hypoid gears show many times the fatigue life of spiral bevels, when tested under the same conditions. Some forty tests on hypoid axles run to date showed an average of 1,135,000 cycles of the pinion for a fatigue failure, and a minimum of 287,642 cycles. These tests gave some indication of the relative importance of the various factors affecting the fatigue strength of gear teeth.

Rigidity of the gear mountings comes first. In practically all cases of gear-tooth breakage, a fatigue fracture starts at the root of the pinion tooth at the large end, where the stress is concentrated under heavy loads. Reducing stress concentration at the heel by the use of a short toe bearing in assembly is limited by the increasing difficulty in obtaining quiet gears as the contact is shortened and positioned closer to the toe. It is much better to stiffen the gear mountings to reduce deflections of the gear and pinion. Pinions are designed with a generous fillet at the root, the cutters being made with as large a radius as practical. Improvements in tooth spacing are reflected in lower tooth stresses and greater durability of the gears.

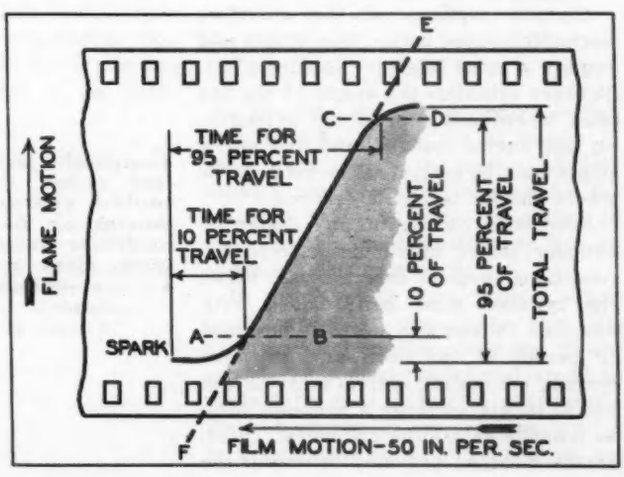
The author also discussed the lubrication of hypoid gears. At the Gleason Works, lubrication requirements of such gears are determined by means of a four-square axle-testing machine, two axle assemblies forming a closed system. A torque load is applied by means of a "wind-up" mechanism and the system is rotated by an electric motor. The machine is first brought up to a speed equivalent to approximately 25 m.p.h. in the car and then the load is applied gradually, building up to the equivalent of full engine torque through second gear in about one minute and a half. The test is run with the load on the driving side of the gears until the temperature reaches 200 deg. Fahr. and on the coasting side for eight hours, holding the temperature of the oil to 250 deg. Fahr. by water cooling.

For a high degree of surface durability it is necessary to maintain the maximum possible degree of surface hardness in both the gear and pinion. The usual penetration test for hardness does not reveal a soft skin, and the best check on surface hardness is a file test. It should be impossible to "cut" the tooth surface of either member with a sharp XF file.

Experimental Study of Flame Travel in Otto-Cycle Engines

An experimental study of the effect of various variables on the velocity of flame travel in Otto-cycle engines, carried out at Massachusetts Institute of Technology, was dealt with in a paper by C. L. Bouchard, C. Fayette Taylor and E. S. Taylor. Flame-trace photographs were taken on a moving film, through a glass window slot in the engine cylinder of a small single-cylinder test engine. The technique was the same as that employed by Withrow and Boyd, and the investigation covered a considerable range of operating conditions, including altitude, with and without supercharging, inlet temperature, humidity of the intake air, engine speed, ignition timing, and air/fuel ratio. Velocity of flame travel is the chief factor affecting the rate of pressure rise in the cylinder, and therefore has an important effect on the performance of the engine.

The curve of flame speed against time (see drawing) can be roughly divided into three parts: An initial period of rapidly increasing velocity, a period of more or less constant flame speed, and, near the end of the flame travel, a period of decreasing velocity. It was decided that, for all practical purposes, measurements of the time occupied by the initial period, the total time for the flame to travel across the combustion chamber, and the maximum speed of the flame in the middle period,



Trace of flame front on film

would be satisfactory as indices of the particular curves.

Under practically all conditions the initial period of slow burning at the start of combustion, was found to occupy about ten per cent of the distance across the combustion chamber. The time occupied for the initial ten per cent of flame travel was therefore used as a measure of this phase. For the main part of the curve, the average flame speed, as determined by the slope of the curve, was chosen. It is difficult to pick out the point on the film where the flame has just reached the cylinder wall, and 95 per cent of the total length of flame travel was finally chosen as the distance over which to measure the time required for the completion of the process (line *C-D*).

Under conditions of normal combustion without detonation, the general nature of the movement of the flame front is as described in the preceding paragraph. The speed of the flame front is increased (and the times of 10 per cent and 95 per cent of flame travel are reduced) by an increase in the pressure level at which combustion occurs, a decrease in the initial temperature, a decrease in the proportion of residual gas, and an increase in small-scale turbulance.

The average flame speeds during the initial period, the period of rapid flame travel and the period of low flame speed near the end of the process, tend to vary in the same direction over a wide range of engine variables. Generally the initial period of slow flame travel occupies from 25 to 30 per cent of the total time required for combustion.

Installing Air-Cooled Engine of the In-Line Type in Aircraft

PROBLEMS connected with the design and installation of in-line air-cooled aircraft engines were discussed in a paper by A. T. Gregory of the Ranger Engineering Corporation. The cooling of such an engine involves the building up of pressure on one side of the cylinder bank and the creation of suction on the other side. In this way a cross flow is induced, causing the air to flow around the cylinders. In some of the first designs of such engines it was found that, contrary to what might be expected, the rear cylinders cooled much better than the front ones. Analysis showed that this was due to the fact that the air from the propeller enters the scoop at high velocity but at very low static pressure, and it is only when the velocity is converted into static pressure, near the rear end of the jacket, that a high rate of cross flow is produced. The solution of the problem lies in building up as high a static pressure as possible in the jacket.

Certain portions of the cylinders normally become hotter than others and require a more intensive cooling effect. Between cylinders the height of the fins must be reduced in order not to lengthen the engine unduly, and the spark plugs must be located at the very points where the fin height is reduced.

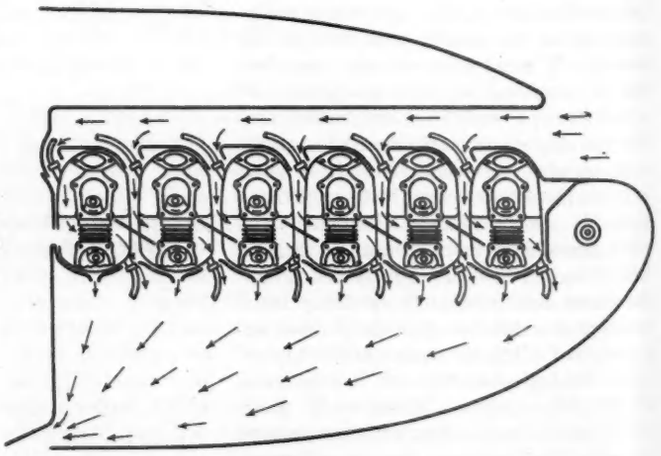
Successful cooling of any design of cylinder under maximum-performance conditions involves three steps. First, the cylinder must be provided with adequate fin surfaces properly designed to permit of the necessary air flow. Second, the cooling system must be laid out to obtain as large a pressure drop as possible across the cylinders. Third, means must be provided to obtain the necessary control of the direction and velocity of the cooling air so as to cool the hottest portion of the engine more effectively.

Air-jacketing of the line engine is a rather simple matter. With rear or outside baffles bearing tightly against the fins, one half of the jacket is finished. It is only necessary to place a plate along the cylinder bank on the high-pressure side to complete the jacket. This plate separates the cylinders from the cooling air in the scoop. Orifices in the plate admit the air into the jacket, which latter will have a pressure intermediate between that in the scoop and that outside of the engine.

The most important duty of the orifice plate is to cause a large proportion of the cooling air to strike the cylinders first at the hottest points at a relatively high velocity. The drawing reproduced herewith shows the complete air jacket on the engine and illustrates how the desired air-flow conditions are obtained for cooling the spark plugs and the areas adjacent to the plug bosses. The incoming air impinges directly against the spark plugs, and after passing around the cylinders, leaves the jacket through spark-plug holes in the rear baffles. The rear baffle is clamped tight against the cylinder fins, bringing the air into intimate contact with the cylinders, and in addition it completely blocks the space between adjacent cylinders, thus forcing the air to flow out either between the fins or over the rear spark plugs and adjacent cylinder walls.

Installation of these air jackets on a V-12 engine made it possible to hold all 24 spark plugs within a temperature range of 100 deg. Fahr. with the engine under severe operating conditions, and to lower the spark-plug temperature by more than 50 deg. Barrel temperatures were slightly raised by the installation of the jacket, but the barrels still remained relatively cool.

The author also discussed the installation of in-line air-cooled engines in the plane, engine weight, valve gear, number of valves per cylinder, and lubrication. He gave a table of weights of the Ranger SGV 770 12-cylinder V engine and accessories, according to which the propeller weighs 102.0 lb.; the engine, 635.0 lb.; starter, 32.0 lb.; generator with control box, 16.8 lb.; exhaust manifolds, 26.0 lb.; carburetor heater and air scoop, 18.0 lb.; engine cowl, 65 lb.; engine mount, 28.0 lb.; oil cooler, 16.0 lb.; oil and gas lines and connections, 8 lb., making the total 946.8 lb. for an engine having a maximum output rating of 420 hp., or 2.25 lb. per hp.



Completely-jacketed in-line air-cooled engine, showing air flow conditions around spark plugs and over cylinder heads

Style of Inside Fitting Must Coincide with Body Design

FREDERIC A. SELJE, director of interior art and body design of Chrysler Corporation, said that in his opinion the interior of a car body should reflect something of its exterior styling, just as one would expect good architectural design to follow the same period throughout a structure.

Now, the radiator enclosure and hood louvres are the principal exterior body features, and not only do they set the style note for the car itself, but they also serve to distinguish one make from another. Therefore, the designer should employ these lines as a motif around which to develop the interior scheme. With the motif thus established, he is then prepared to repeat or reflect it, with appropriate modifications, on the instrument panel, hardware, seat cushions and backs, door panels and body cloth. By continuing this one motif throughout the design, harmony, repose and a sense of fitness are created.

The author said he personally preferred not to use the same body cloth throughout the entire interior, but to use two shades of one color, placing the lighter shade on the sidewalls, door panels and ceiling, and the darker shade on the seat-backs and cushions. A similar effect can be secured by using a plain cloth of a given color on the side walls, door panels and ceiling, and a patterned material of the same color on the seat-backs and cushions. These combinations would add much needed freshness to the interiors without complicating line procedure or increasing costs. A simply designed and well executed car interior creates a sense of mental repose and well-being.

Finally, and most important, the interior of the body should be made safe by the elimination of all possible projections with which the passenger may collide or over which he might trip; and all surfaces which come into normal contact with his person should be as smooth and soft as possible.

Control for Chassis Dynamometer of the Electric Type

A CONTROL for chassis dynamometers of the electric type by which the torque load on the engine can be made to vary automatically with the speed in the same way as in road operation, was described by J. R. McGregor and L. T. Folsom, research engineers of the Standard Oil Co. of California. It was explained that the power required to overcome rolling resistance varies as the first, and that required to overcome air resistance, as the third power of the speed, hence the total power required varies substantially as some power of the speed intermediate between the first and the third. One of the authors, Mr. Folsom, developed a circuit for use with an electric dynamometer by means of which it is possible to obtain practically any torque-speed curve desired, and the circuit has been patented to him under No. 2,054,076.

Referring to the circuit diagram herewith (Fig. 1), the main generator is driven by the car being tested, and the power generated by it is dissipated through the heavy rheostat R_1. The shunt field of the main generator is energized through rheostat R_2 by an exciter that is motor-driven at constant speed. This exciter has a double field—the normal shunt field, energized from a constant-potential source, and the normal compound field, energized from the main generator through rheostat R_3 and the reversing switch. By means of the switch the compound field may be made to either aid or oppose the normal shunt field.

If the reversing switch is left open and the shunt field of the exciter carries a constant current from the external source, excitation of the main generator will be constant, and the voltage generated will be directly proportional to the speed. The power generated then varies as the square of the speed.

Now let the reversing switch be closed, so that the excitation of the exciter by the compound field opposes the excitation by the shunt field. Referring to Fig. 2, assume that the main generator is operating at 2000 r.p.m. and developing 170 volts, and that a change to 1500 r.p.m. occurs. If the excitation remained the same, the main-generator voltage would fall to 128, as indicated by the straight line. This decrease in voltage would result in a decrease of the current through the exciter compound field. Since it has been assumed that the compound field is opposing the shunt field, it is evident that the net excitation of the exciter will be increased, resulting in an increase of its terminal voltage. An increase in the excitation of the main generator results, which prevents its voltage falling as much as was originally assumed. If this cycle of events is followed several times, it will be found that the terminal voltage of the main generator becomes stable as indicated by the upper or curved line.

The resulting curve of generator-voltage versus speed has an exponent for the speed factor of less than unity. It follows that the equation for the power generated has an exponent of less than 2. Had the reversing switch been closed, so that the excitation of the exciter due to the compound field assisted that due to the shunt field, the equation for the power generated in terms of the speed would have had an exponent greater than 2.

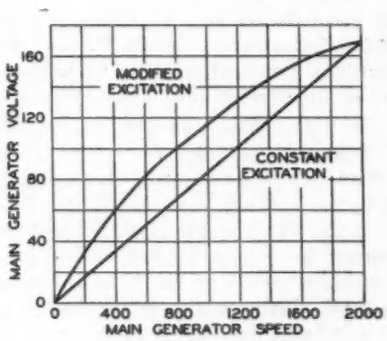


Fig. 2—Field voltage vs. generator speed

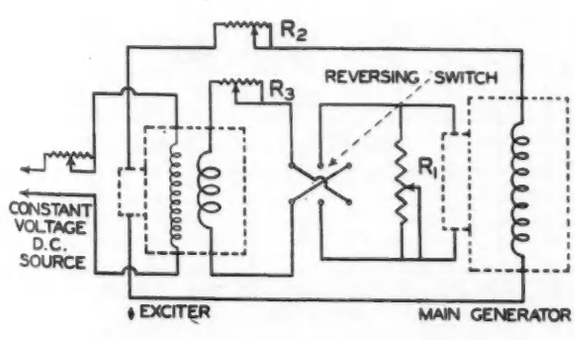


Fig. 1 — Circuit diagram for automatic dynamometer control

In development work with a small dynamometer it was found that the agreement obtainable between power required and power developed would be made quite good. (Fig. 3). The maximum deviation in the regions considered pertinent to performance testing

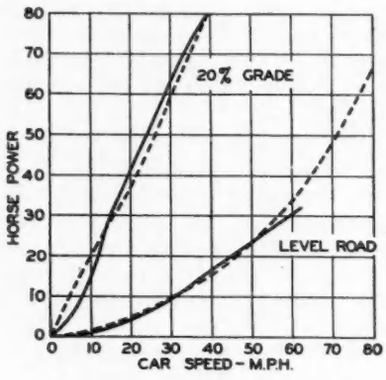


Fig. 3—Horse power required to drive vehicle (full line) and horse power absorbed (dotted line) vs. car speed

was 2 hp. (equivalent to about 3 m.p.h. on a level road and to 1 m.p.h. on a 20 per cent grade). There is relatively poor agreement between the power-absorbed and the power-required curves under conditions of low speed and heavy grade, and of high speed and light grade, but these conditions are outside the region of greatest interest.

The adjustment of the circuit to accommodate different cars and road grades is very simple. The controls to be set are rheostats R_1 and R_3. Rheostat R_1 determines the load at maximum speed and R_3 the amount of feed back to control the grade. R_2 and R_4 are solely for purposes of standardizing the circuits involved. The settings for R_1 and R_3 would be obtained from tables prepared when the design was made.

Fuel Consumption of Cars with House Trailers

ACCORDING to James H. Booth of Buick Motor Co., the problems with which the house trailer confronts the automobile manufacturer are of the nature of nightmares. Present-day automobiles are designed for economical operation; they have no excess weight, and the extra stresses to which a 2500-lb. trailer subjects many parts of the car cannot fail to have harmful effects. It would be easy enough to design a car specially to haul a trailer, but the trailer industry at present would not absorb a sufficient number to warrant the production of such special models.

The first problem that arises is that of a suitable hitch. At present, car frames are not designed to accommodate such a hitch, and the author said he could not see sufficient volume to warrant burdening all automobile production by providing the type of frame required. Many of the hitches at present employed are faulty in one way or another. The hitch, of course, should be designed to permit normal operation of the bumper, and opening and closing of the rear-deck or trunk door. The point of attachment to the trailer should be ahead of the bumper, to eliminate danger of locking with other cars when the car is being used without trailer. Ground clearance of the hitch should be as much as that of any sprung member of the car.

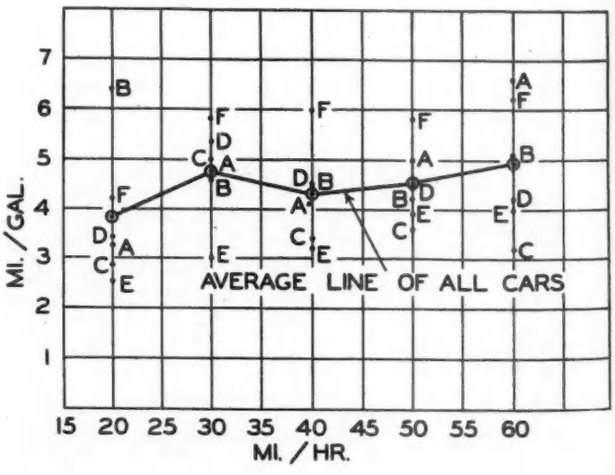
Trailers not only impose a drawbar load on the car, but also add to the load transfer from the front to the rear wheels due to the driving torque.

Mr. Booth suggested that trailer manufacturers provide their vehicles with draw bars having a limited range of adjustment on the trailer frame, so as to make it possible to match the height of the coupling or hitch on the car. Rear tires of cars are usually slightly overloaded even with only the normal full passenger load, and if the load on them is added to by a trailer they are usually greatly overloaded. The drawbar load also shifts more weight from the front to the rear tires, with the result that, as shown by tests, the handling qualities of the car are seriously impaired. By increasing the inflation pressure of the rear tires to 20 lb. per sq. in. above normal, the handling qualities can be restored, but this calls for six-ply tires in all cases, and for oversize tires in some. Adding leaves to the rear springs solves the springing problem with the trailer attached, but gives an unsatisfactory ride without the trailer.

All parts of the transmission and drive, including axles, gears, bearings, drive shaft, transmission unit and clutch, have additional loads imposed upon them by the house trailer, the transmissions particularly because many more gear changes must be made. In hilly country, cars with trailers attached are often driven up hill at 40 m.p.h. in second gear, and coasted down hill in the same gear at approximately the same speed, to save the brakes.

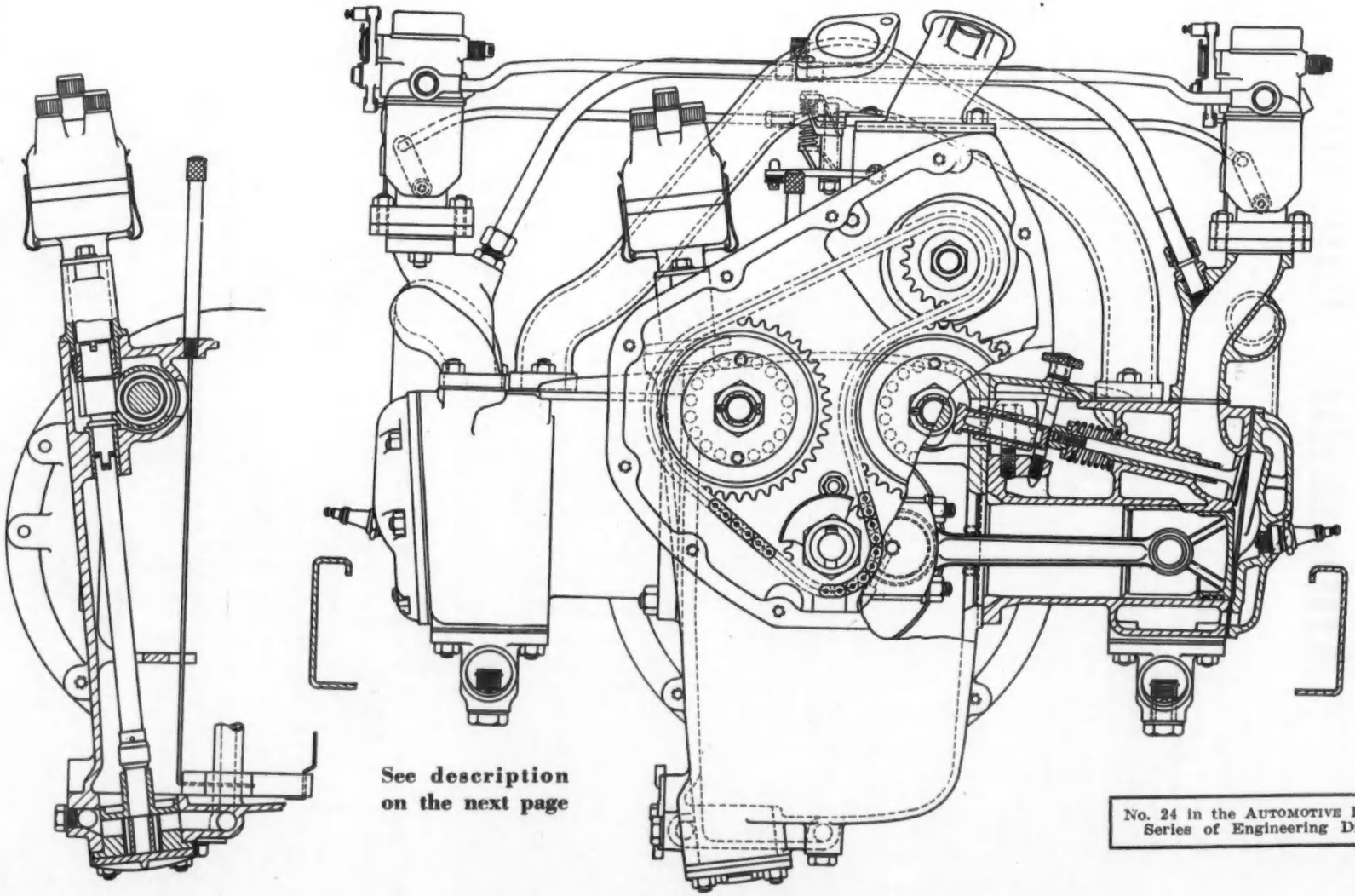
As more experience in trailer haulage accumulates, more knowledge will be gained regarding the weak links in the transmission train, and these can be suitably strengthened. Brakes are not causing the car manufacturer much worry today, as most of the larger house trailers are provided with brakes of their own. Demands on both the cooling system and the electrical system are increased by the trailer. The former is particularly likely to show signs of overload when a trailer is being hauled in high altitudes in hot weather, and the author mentioned a case where a trailer-hauling car boiled its water all the way across the state of Arizona. As regards electrical equipment, it may become advisable to install special generators driven from the trailer wheels, as the car manufacturer cannot burden the average car owner with the expense of additional generating capacity to supply the needs of a trailer. Fuel mileage of cars naturally are reduced by a trailer, and the reductions for six different cars are plotted in the accompanying graph.

In conclusion the author said he could not agree with the facetious remark of Philip H. Smith that "trailers had been going round and round and had not come out any place yet"; they had come out, and had landed squarely in the car designer's lap.



Graph showing the reduction in m.p.g. of six cars with trailers attached the zero line—fuel consumption of the same cars without trailers

Jowett "Flat Four" Automobile Engine



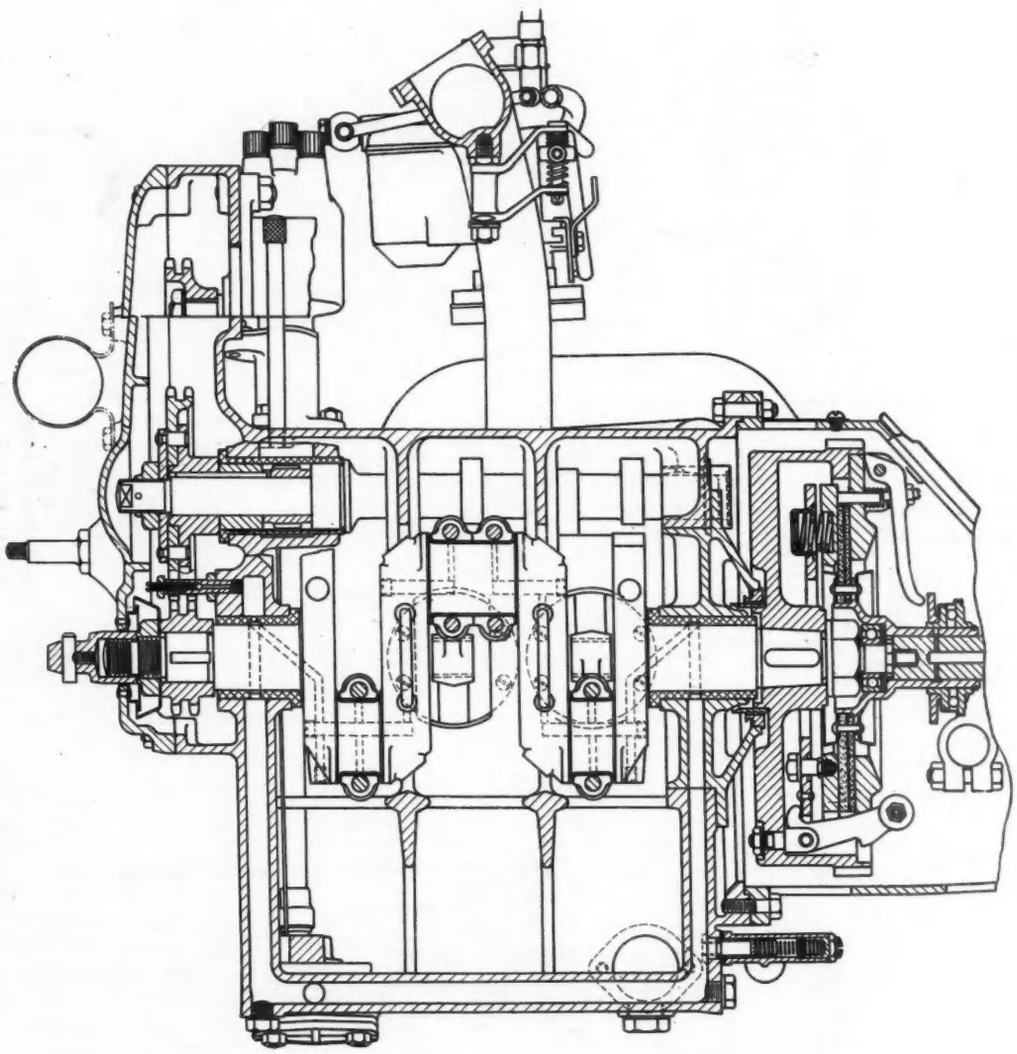
See description on the next page

No. 24 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Jowett "Flat Four" Automobile Engine

This British engine has a bore and stroke of 2½ by 3⅝ in. (71.2 cu. in.). The cast iron cylinders, cast in pairs, with detachable L heads, are bolted to an aluminum crankcase. A pair of connecting-rod big-end bearings are mounted side by side on the central crankpin of the three-throw, two-bearing crankshaft.

Although the cross-sectional view shows two carburetors with a balance pipe, only one carburetor—a Zenith downdraft—is now being fitted. It is at the center of the aluminum, water-heated inlet pipe, bridging the engine as a whole. Lubrication is by pressure to the main and big-end bearings, with two filters, on the suction and pressure sides of the submerged pump respectively. The engine has thermosiphon water circulation, with thermostatic control. Aluminum pistons are used. A feature of note is a three-point mounting on flexible supports with hydraulic dampers. The detail view on the preceding page shows the oil-pump and distributor drive.



Foundry Layout Facilitates Quality Control

(Continued from page 692)

sifted over a coarse sieve which rejects the large lumps and slugs of metal; then it moves into another chamber where it is passed over a vibrating screen, through a comb, and then out of the machine. The sand is thrown out by centrifugal force with its trajectory so adjusted by a guard as to deposit it directly into the bins without spilling over the floor.

After pouring, the castings are broken away from the gates and are moved to a tumbling machine to remove sharp edges and projections. Then they are transported to the inspection department where the operators look for visual defects and check conformity to general dimensions as well as freedom from warpage.

An interesting feature of the inspection procedure is the fact that random samples are ground and machined to test the general level of quality before the castings enter the machine shop.

AUTOMOTIVE ABSTRACTS

Piston Temperatures in Sleeve-Valve Oil Engine

A paper on the above subject was read before the Internal-Combustion-Engine Group of the Institution of Mechanical Engineers (Great Britain) by Dr. Wright Baker recently. The experiments were carried out on a three-cylinder Mirrlees-Ricardo engine of 5⅝-in. bore and 6¼-in. stroke. Three different designs of piston were used, one of cast iron, the other two of aluminum alloys (the Y alloy and the L8 alloy respectively). The speed of the engine could be held down by governor to 1200 r.p.m. with the iron pistons and 1400 r.p.m. with the alloy pistons. Valving functions in this engine are preformed by a single cast iron sleeve having a thickness of 0.215 in. The combustion chamber is of cylindrical form and is located centrally in the cylinder head. Thermo couples were inserted in the piston centrally in the head, half-way out to the circumference, at the circumference of the head, at the top of the ring belt, the center of the ring belt, and the center of the skirt. In both of the first-mentioned positions the temperature was measured at both the top and the bottom of the cylinder head.

Warming up curves were obtained with both the cast iron and the L8 aluminum pistons and it was found that warming up required approximately twice as long with cast iron as with aluminum.

All temperatures measured naturally increased with the horse power output. With the cast iron piston the temperature at the center of the piston head increased from about 450 deg. at 20 hp. to about 830 deg. F. at 60 hp. At the center of the piston head the rise in temperature was somewhat more rapid than the increase in load, an increase in load from 55 to 60 hp., for instance, giving rise to a considerably greater temperature increase than an increase in the load from 20 to 25 hp. On the skirt the temperature rose substantially in proportion to the load. With the aluminum pistons the temperatures were much lower. Thus in the case of L8 pistons the temperature at the center of the piston head increased from about 310 deg. F. for 20 hp. to about 455 deg. Fahr. at 60 hp. When the b.m.e.p. was held constant the temperature of the center of the piston head varied linearly with the engine speed. An increase in the speed from 800 to 1400 r.p.m. at a b.m.e.p. of 64.7 lb. per sq. in. and an injection timing of 21 deg. before top center increased the temperature at the center of the piston head from 350 to 425 deg. F., or 75 deg. F. At the circumference of the head the difference is 55 deg. F. and at the skirt, 29 deg. F.

The influence of the water temperature on the temperature of the piston was also investigated. By increasing the water outlet temperature from 110 to 170 deg. F., the temperature of the lower half of the cylinder walls and the piston was increased by only about 3 deg. F. at light load, while there was practically no difference at full load.—*Engineering.*

The Laws of Spark Advance

Spark-advance requirements were discussed in a paper recently read before the (French) Society of Automobile Engineers by Pierre Prevost, an engineer of the Jupiter Petroleum Co. M. Prevost said

the optimum advance was determined by a number of factors, including the compression ratio (and volumetric efficiency), the fuel used (and particularly its octane number), the r.p.m. of the engine, the load, the temperature (of the carburetor air, the cooling water, the lubricating oil, and of hot spots), the quality of the spark plugs, the richness of the mixture, and the condition of the engine.

Owing to manufacturing tolerances, the compression ratio for a given lot of engines may vary by as much as 0.3, so that if the standard ratio is 5.95, for instance, the ratio may attain a maximum value of 6.1 and a minimum of 5.8. The octane number is an important factor in the maximum advance which can be used satisfactorily, and it is, of course, essential that it be possible to use commercial fuels. In France motor fuels are divided into three grades by a decree issued Nov. 15, 1935, viz., the tourist grade, with a minimum octane number of 60 (62 if mixed with alcohol); the commercial-vehicle grade, with a minimum octane number of 62, and the so-called super fuels, with octane numbers of at least 75.

The influences of the various factors on the optimum spark advance were shown by means of charts or diagrams. It is pointed out that the diagrams are not of general application and that each case must be studied separately. The effect of compression ratio is illustrated by the following table of optimum advances at different speeds for compression ratios of 5.7 and 6 respectively:

R.P.M.	1000	2000	3000	4000
Spark Adv. (5.7 C.R.)	15	32	45	47
Spark Adv. (6 C.R.)	10	24	37	40

The influence of the octane number of the fuel is given by the following table:

R.P.M.	1500	2000	2500	3000
71 octane	23	34	43	46
60 octane	9	23	37	40

Another chart showed the influence of temperature. In the "hot" engine the water was kept at 194 deg. F. and the air at 140 deg., while in the cold engine the water was kept at 122 deg. F. and the air at 50 deg. F.

R.P.M.	1500	2000	2500	3000
Cold Engine	24	33	41	43
Hot Engine	10	23	36	40

The author says that a hand adjustment (sometimes called an octane selector) is the only means permitting of taking account of the fuel qualities, and of temperature variations; that it permits of obtaining a more satisfactory advance curve for the average case, of correcting defects in the automatic advance or in the setting of the distributor, of eliminating pinging, and of improving the idling.

In the author's opinion, vacuum control of the spark advance is necessary in order to assure the correct advance at low loads. The spark-advance system of the engine therefore should comprise a hand adjustment, a speed-sensitive control, and a load-sensitive control.

In conclusion the speaker said he wanted to emphasize two things, the first being that there is no well-determined law of spark advance but a zone; the second, that the spark advance is a means of controlling detonation. It would be a mistake not to take advantage of this means because this control permits of slightly increasing the compression beyond what is generally considered the limit, or of making use, in case of need, of fuels which are more detonating than the regular grade.—*Journal of the* (French) *Society of Automobile Engineers.*

New Aluminum Alloys

Junkers Motor Manufacturing Co. has recently taken out a series of patents bearing on aluminum alloys having good bearing properties and therefore suitable for plain or parallel bearings, guides, pistons, etc. One patent covers alloys with from 0.1 to 16 per cent of magnesium, 0.5 to 10 per cent of iron and the rest aluminum. These alloys are said to be exceptionally malleable, so that they can be used not only for castings but also for parts that must be rolled, forged, stamped, etc. Another patent covers a series of aluminum-copper-zinc-iron alloys. Optimum results are said to be obtained from alloys with approximately equal copper and zinc contents, as, for instance, 8 per cent copper and zinc each and 6 per cent iron. A third patent covers machine parts made of an aluminum alloy containing from 9 to 22 per cent of copper and 4 to 15 per cent of copper, the preferred composition being 15 per cent copper and 6 per cent iron—*Revue de l'Aluminium.*

Expansion of British Aircraft-Engine Industry

The large expansion in the British aircraft industry due to the rearmament plans of the British Government, is brought out in *Engineering's* annual review of that industry. Appropriations in the "air estimates" for 1935 and 1936 included no less than £6,000,000 for aircraft engines and £1,100,000 for aircraft engine parts (spares). The British Government is at present creating a "war potential" or "shadow industry" by the construction of Government factories, equipped for production but not intended to produce except in times of emergency, and with the function of providing the industry with an elasticity of output not obtainable under purely private control. Six factories are being built for the production of engines. The capital necessary for the construction and equipment of these factories is being

provided by the Government, while the management has been placed in the hands of mainly automobile manufacturers, who will be remunerated on a turn-over basis, it is understood. The manufacturers concerned are: Austin, Bristol (Aeroplane), Daimler, Rootes, Rover and Standard.

A high degree of standardization has been aimed at throughout and only Bristol air-cooled engines will be manufactured in the Government factories. Rolls-Royce were invited to take part but declined. The production of engine parts is to be divided between the six factories. However, it is planned to ultimately arrange for three separate chains of parts manufacture.

Owing to the pressure of work for the Air Ministry, British manufacturers have suspended development work on Diesel aircraft engines, which are considered less suitable than carburetor engines for military aircraft. The chief difficulty of the industry in meeting the greatly increased demand for military aircraft and engines has been a shortage of skilled labor, particularly of tool makers and sheet-metal workers.

Before the R.A.F. expansion, Air Ministry orders accounted for a much as 70 per cent of the total turnover of the industry, exports amounting to roughly 20 per cent and home civil aviation for 10 per cent. It is believed that at the present time the Air Ministry quota is more than 90 per cent.—*Engineering.*

The Four-Cylinder Engine

In a paper on "The Four-Cylinder Engine" read before the Institution of Automobile Engineers by G. F. Gibson, experimental engineer of Vauxhall Motors, Ltd., the effect of gas pressure behind the piston rings, and especially behind the top ring, was discussed. In order to obtain evidence on the question the author decided to make comparative tests on an engine by drilling behind the rings. An engine was assembled with two pistons drilled behind the top ring, two drilled behind the second ring, and two drilled behind both top rings. The third ring in this engine was an oil-scraper ring and its groove was already drilled.

The engine was run for 10,000 miles and the cylinder bore was measured. It was found that in the case of the two pistons where the ring grooves had been drilled behind both of the top rings the rate of wear was only 25 per cent of the average experienced with such engines, run under similar conditions. Unfortunately this method of reducing the bore wear cannot be used in practice, because of the blow-by through the drill holes.

One thing this experiment taught the author was that excessive crankcase pressure due to blow-by can be the cause of an oil consumption that would hardly be credited. As to practical means of reducing the pressure back of piston rings, and the bore wear caused thereby, the author suggests decreasing the top land clearance and increasing the length of the land. Another suggestion is the use of solid (unsplit) floating rings, which would involve the use of a composite piston design (to get the ring into place). This, besides protecting the other rings, would not be influenced itself by the pressure "built-up." *Journal of the Institution of Automobile Engineers.*

Progress in Hydrogenation

Great progress has been made in the technique of the hydrogenation of solid and liquid fuels in recent months. At the beginning of 1937 the aggregate capacity of hydrogenation plants throughout the world was 1,900,000 tons of gasoline per year. This will certainly not be the limit, for the consumption of liquid fuels is increasing at an unprecedented rate. On the other hand, the sources of good crude oil are becoming scarcer right along. The crudes from new wells are generally of a heavier character and contain more sulfur, and this makes the refining processes more difficult and more expensive. It is therefore quite likely that hydrogenation will be resorted to, with a view to producing gasolines of high octane number and which contain less sulfur and gum.

One important problem remains to be solved, and that is the high cost of the installation required per unit of annual output. It is estimated that an installation with an annual output of 100,000 tons necessitates an investment of approximately 350 million francs (about 16 million dollars), a very considerable sum in view of the fact that the annual turnover is only about 150 million francs ($7,000,000). At the present time such an industry could not exist were it not for the fact that it is a war industry. This accounts for the prodigious efforts now being made to reduce the cost of hydrogenation. Research work on methods of hydrogen production, on suspension oils (in which the powdered coal is held in suspension), on catalysts, and on the design and operation of catalytic tubes already justifies the hope that material improvements will be accomplished. Whenever a new hydrogenation plant is projected, each of the items listed should be made the subject of a detailed study, from the point of view of the available local resources.—Chas. Berthelot in *Genie Civil.*

The Trolley Bus

A two-part paper on "The Trolley Bus" was published in a recent issue of the Journal of the Institution of Automobile Enginers. The first paper, dealing with "The Mechanical Aspect" was by J. C. Dabbs, chief designer, Sunbeam Commercial Vehicles, Ltd., while the second part, "The Electrical Aspect" was by E. T. Hippisley, manager, traction sales, the British Thomson-Houston Co., Ltd. In "Part I" the following topics are discussed: Positions for Control Equipment, Position for Resistances, Details of Design and Con-

struction, Rear Axles, Bogie Design on Six-Wheelers, Frame Design, Braking Systems, Air-Pressure Braking, Suspension, Transmission Shafts, and Bodywork. In Part II the following topics are covered: Electrical Equipment, Collector Gear, Wireless Interference, Control Schemes, Performance, and Operating Costs. In an Appendix a comparison is made between the costs of operation of gasoline, Diesel and trolley buses.—*Journal of the Institution of Automobile Engineers.*

Fuel Injection Experiments for Diesel Using Cathode Indicator

Some experimental work on fuel injection equipment for Diesel engines was done at Kings College, London, by S. J. Davies and A. W. Rowe and was dealt with in an I.A.E. paper. A cathode-ray indicator was developed for this investigation. Various pressure units were tried in this indicator and a carbon pile was finally adopted. The lift of the nozzle valve was recorded by extending the valve stem and using a photo-electric cell. The fuel pump used in the work was of Bryce design and was usually combined with a Bryce injection nozzle. In some of the tests the pump was fitted with a Bryce delivery valve which relieved the line of pressure at the end of the pump delivery period, but in special cases delivery valves of other types were used. The following conclusions were drawn from the results of the experiments:

1. Opening and closing pressures are in proportion to the effective area of the open-nozzle valve and the area exposed to the oil pressure when the valve is closed.

2. The actions of the volumes of oil (a) in the pump and (b) at the nozzle is to modify considerably the pressure diagram calculated from simple reflections in the piping.

3. Leakage from the system causes a fall of residual pressure between injections, thus affecting nozzle lag. Leakage is naturally less with a more viscous fuel. It is not marked in the usual systems when they are in good order.

4. Increase of pump speed increases the injection angle, increases the maximum nozzle pressure, and modifies the total injection lag.

5. Rough running caused by alternating injection characteristics is common, and the pump and injection setting for normal running should avoid such instability. Eight-stroking when idling should similarly be avoided.

6. Increased nozzle-opening pressures lead to increased nozzle lag, higher pressures throughout injection, smaller needle lifts, greater liability to needle chatter, and cyclic variations at low speeds, smoother pressure curves at higher speeds, earlier closing of nozzle valve, and generaly give better atomization and penetration.

7. Limiting the lift of the nozzle valve to a value just above that causing "throttling," leads to higher pressures during the main part of the injection, and thus gives better atomization and penetration.

8. No "nozzle-valve bounce" has been observed, such apparent action being always associated with suitable pressure variations to cause it.

9. The weight of the nozzle is of negligible importance. Friction of the nozzle parts has normally little influence on the process.

10. Increased pipe diameter causes flatter pressure waves, and these, at lower speeds, cause greater nozzle lag. At higher speeds this increased nozzle lag is offset by the higher residual pressures in large pipes. Too small a diameter, by increasing frictional resistance, causes excessive loss of pressure at the nozzle. Intermittent action is more likely from the steepness of the initial waves and the smaller nozzle pressures after flow begins.

11. Large nozzle diameters give low residual pressures and thus greater nozzle lag. Too small a nozzle prolongs injection considerably, especially at high speeds and high nozzle-opening pressures.

12. Very long pipes cause lower values of pressure after nozzle opening, since the reflected waves, which assist in building up the pressures, arrive late. Pipe lag increases with speed. Altogether, pipes should be as short as possible.—*Journal of the Institution of Automobile Engineers.*

Book Reviews

Beiträge zur Flugtechnick (Contributions to Aircraft Engineering) has been published by Julius Springer, Vienna, Austria, under the editorship of Ing. Richard Kratzmayr, professor of aircraft engineering and director of the aerodynamic laboratory of Vienna Technical College. It is an anniversary publication, commemorating the inauguration of the aerodynamic laboratory 25 years ago, and contains contributions from seven members of the original staff.

At the end of the world war aeronautic development came to a sudden stop in Austria, and the members of the laboratory staff with few exceptions went abroad: in fact, most of them seem to have remained abroad to this day, for four of the seven contributors to the publication under review give their addresses as Paris, Silver Lake (Ohio), Istanbul and Hannover, respectively. The seven "contributions" have the following headings: Short Description of the Aerodynamic Laboratory; Conditions of Adhesion of Circulatory Flows in Viscous Liquids; Contribution to the Theory of Phygoids; A 600-H.P. Giant Airplane of 1916; Problems of Trailer Flight; A Contribution to the Statics of Cellular Structures; Concerning the Resistance to Buckling of Airplane Struts of Variable Cross Section, and Contribution to the Calculation of Box Girders.